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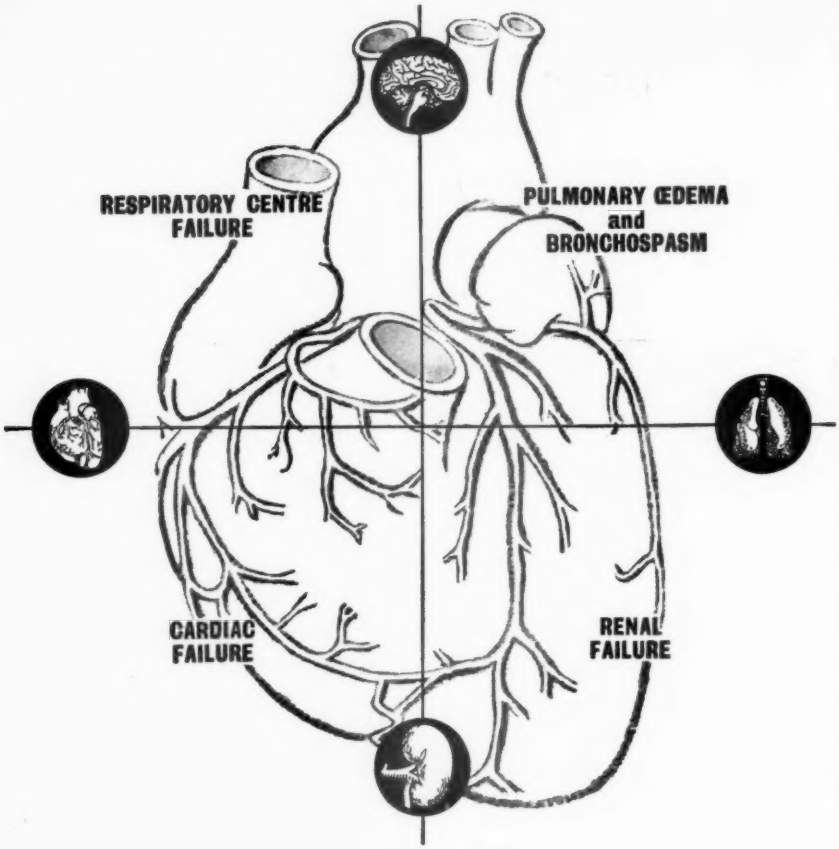

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(3) (1952) *Ann. Endocrinol.*, **13**, No. 5, 883

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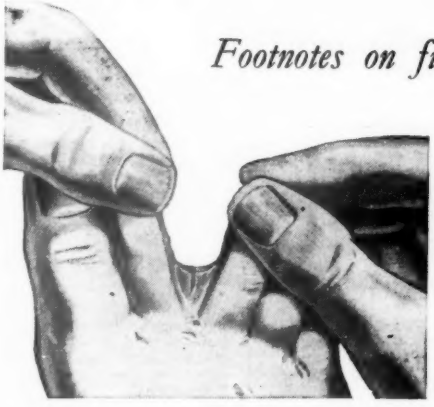

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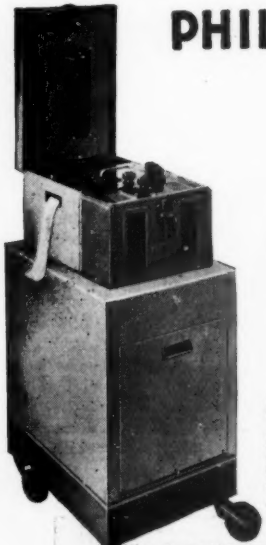

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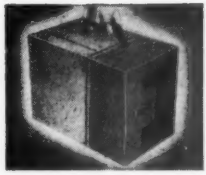

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on the Occasion
of
Her Coronation
June 2 1953

To The Queen's Most Excellent Majesty.

Most Gracious Sovereign,

WE, Your Majesty's dutiful and loyal subjects, the President and Fellows of the

Royal Society of Medicine,

approach Your Majesty with expressions of our sincerest felicitations on the auspicious event of Your Majesty's Coronation.

AT the same time we desire to express our gratitude and deep satisfaction at the encouragement graciously given by Your Majesty in assuming the Patronage of our Society.

WE assure Your Majesty of our loyal devotion to the Throne and to Your Majesty's Person, and of our aspirations for the happiness and prosperity of Your Reign.

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Portrait by Dorothy Wilding

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Section of Proctology

President—O. V. LLOYD-DAVIES, M.S., F.R.C.S.

[*November* 12, 1952]

Diverticulitis

PRESIDENT'S ADDRESS

By O. V. LLOYD-DAVIES, M.S., F.R.C.S.

THE term diverticulitis is now commonly used to imply a disease which involves the colon.

Diverticula occurring elsewhere are always prefixed by the name of the organ affected.

Radical surgery can now be more safely undertaken and my remarks are based mainly upon personal experiences, with the addition of those cases operated upon at St. Mark's Hospital during the last few years.

The first description of diverticula of the colon is that of Cruveilhier in 1849:

"It is among old men—and especially those who were subject to constipation—that we not infrequently find between the bands of longitudinal muscle fibres in the sigmoid, a series of small dark pear-shaped tumours which are formed by hernias of the mucous membrane through the gaps in the muscle coat."

It is true to-day that men are rather more frequently affected than women but constipation is by no means a constant symptom and is almost certainly not the cause of the condition.

Harold Edwards refers to the fickleness of the bowels in these cases.

Following upon Cruveilhier's work isolated cases were noted post mortem from time to time.

J. S. Bristowe, St. Thomas's Hospital Physician, exhibited a typical case of diverticula of the sigmoid to the Pathological Society of London in 1854. Sidney Jones, Surgeon of St. Thomas's Hospital, described very clearly a vesico-colic fistula due to diverticulitis to the same Society five years later.

Arbuthnot Lane also described a case in 1885 and is said by Hurst to have published the first illustration of diverticulosis, but Lane was not at that time particularly interested in colon resections.

In 1857, Habershon, a Guy's Hospital Physician, published a book on gastro-enterology, which is, as far as I can ascertain, the first of its kind in the English language.

He describes diverticulosis very accurately in a chapter on constipation, observing that the sigmoid flexure was most frequently involved, but he did not think the diverticula produced any symptoms or were in any way dangerous.

Despite these observations the condition was for many years regarded as a pathological curiosity of no especial importance. It was not until Graser's paper in 1899 that any real interest was aroused.

He pointed out that the condition was far from uncommon and also described peri-diverticulitis and its resemblance to new growths and from that time diverticulosis of the colon and its complications became established as a definite disease entity. In 1908 Maxwell Telling reviewed all the published work on the subject and in 1916 with Gruner wrote a further extensive review which included the classification of all known complications.

ÆTIOLOGY

It is now generally agreed that diverticula of the colon are acquired: they are false diverticula in type, since when fully developed they possess only two coats, an outer serosal and inner mucosal (Fig. 1).

There is nothing comparable in the large intestines of lower animals and the nearest parallel occurs in pit ponies who have been observed to develop diverticula of the small intestine, but no satisfactory explanation has been found to account for them.

As is well known, diverticula in man may be found distributed throughout the whole colon, but, in the main, it is the left colon and particularly the sigmoid loop which is affected.

They are found between the mesenteric tænia and the two anti-mesenteric tæniæ of the bowel (Fig. 2).

FIG. 1.—Section through a diverticulum.

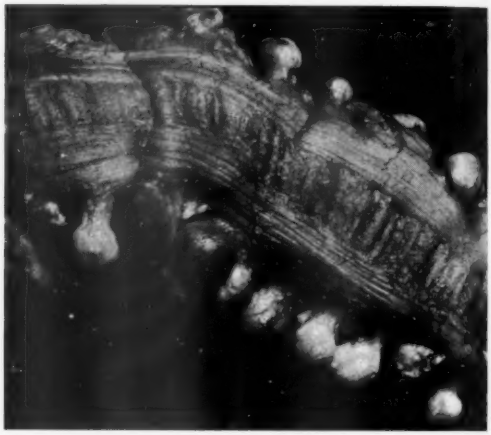

FIG. 2.—Showing relationship of diverticula to longitudinal muscle bands.

Only rarely is the mesenteric tænia penetrated, this being the stoutest of the longitudinal muscle bands and I only recall one case in which the area between the anti-mesenteric bands was involved.

The diverticula are pulsion diverticula and in reading the literature I have encountered fifteen theories, ranging from too much fat to too little fat and back again to hormones.

The most plausible theory as to the initiating factor is that of muscular spasm and irregular contraction of the bowel wall; this view was first put forward by Sir Arthur Keith in 1910 and is fully supported by Edwards and others.

Whether this is a psychosomatic manifestation or some local factor in the nerve plexuses or muscle of the bowel or some other general factor is not clear, but I think it very probable that the initiating factor is a psychosomatic one.

The effect of spasm which presumably goes on for long periods is to narrow the bowel and shorten its length.

The circular muscle is thrown up into folds which project into the lumen like interdigitating valves; hypertrophy may occur and at a later stage fibrosis fixes the affected bowel converting it into a rigid corrugated tube (Fig. 3 and Diagram I).

The increase of intracolic pressure produced by this contraction of the muscle results in herniations of the mucous membrane along paths of least resistance, which were demonstrated by Hamilton Drummond to occur where the mesenteric vessels enter the bowel wall between the mesenteric and anti-mesenteric tæniæ (Fig. 4 and Diagram II).

This explanation of the sites at which diverticula occur appears to be the most logical one and is difficult to refute.

Very occasionally wider congenital gaps in the circular muscle may be found and this phenomenon may account for the large single diverticulum which is sometimes encountered. (Fig. 5)

Once the diverticula have penetrated the muscle coat they are free to develop in size and usually enter an overlying appendix epiploica or enter the leaves of the mesentery where the serosal coat is more lax owing to the fatty tissue.

FIG. 3.—Typical appearance showing irregular infolding of circular muscle.

DIAGRAM I.—Diagram of normal haustrations compared with the irregular contractions associated with diverticulosis.

FIG. 4.—Showing vessels penetrating the circular muscle before reaching the longitudinal muscle band.

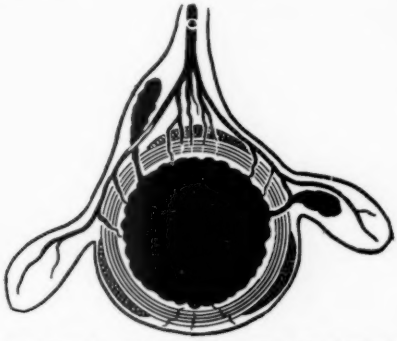

DIAGRAM II.—Hamilton Drummond's classical diagram.

FIG. 5.—Showing congenital gap in muscle wall.

INCIDENCE

No completely accurate figure is available as to the exact incidence of the disease and the published figures are either based upon post-mortem records or X-ray examinations.

It has been suggested that the condition is becoming more common but there are no figures to support this view and the probability is that the disease is now diagnosed more frequently.

The Registrar-General's figure for deaths due to diverticulitis in the past seventeen years has remained quite constant at about 500 per year.

In general the disease affects the over forties, but isolated cases have occurred in the lower age groups and even in children.

Harold Edwards has stated that 16% of patients over the age of 35 having barium enemata examinations at King's College Hospital were found to have diverticula of the colon.

At St. Mark's Hospital Henderson states that the figure ranges between 15 and 20%; of course, these figures are admittedly unreliable in an assessment of the total incidence and it is probable that

FIG. 6.—Showing spasm of the bowel with diverticula simulating a carcinoma.

FIG. 7.—Diverticula and carcinoma in a woman aged 6 The V-shaped gap indicates the site of the growth.

FIG. 8.—Barium enema examination in a case associated with intense spasm.

FIG. 9.—The same case after the administration of Banthine bromide.

the post-mortem figure of 5·2% based on nearly 2,000 examinations at the Mayo Clinic is somewhere nearer the truth. This figure agrees with that quoted at most American clinics for the incidence found at barium enema examinations where possibly more people indulge in this test with less reference to the clinical findings and symptoms than in this country.

The incidence of diverticulitis supervening upon diverticulosis has been computed by various writers; Hurst was of the opinion that diverticulosis does not cause any symptoms, and one frequently finds diverticula in the barium meal examinations of patients who have apparently no symptoms related to them.

Bockus, Spriggs, Edwards and others, however, state that 75% of patients with diverticulosis have symptoms of abdominal discomfort or epigastric and left iliac fossa pain, flatulence and possibly some slight alterations of bowel habit.

One may well ask when does diverticulosis produce symptoms, when do they end and when do those of diverticulitis begin.

It is a difficult matter to decide upon since in any given length of bowel involved by the disease, all stages of the condition may be present.

The figures given by most authors are based upon the number of cases requiring surgical intervention or something more than the usual medical methods of treatment and the percentage varies from 10% to 27%.

It is the cases in this group which interest us particularly.

X-ray Examination

Before 1913 diverticula of the colon were always an accidental finding at post-mortem or operation; but in that year de Quervain in Switzerland diagnosed the condition by means of X-rays. Within a year Case in America published cases diagnosed by this method which was quickly and widely adopted.

X-ray examination of the bowel by means of barium enemata is now a well-established and accurate method of diagnosis. Marxer in 1923 showed that it was possible to diagnose a very early stage in the disease which he termed pre-diverticulosis.

The early X-ray appearances are those of spasm and irritability and the border of the bowel shows minute indentations referred to as palisading, other terms such as ripple, or saw-edge border are also in use to describe this early stage. It is probable that the majority of these cases go on in the course of several years to develop fully formed diverticula. Were this early stage recognized more frequently, it is possible that some preventive measures could be taken to eliminate the persistent spasm and eventual formation of diverticula. However, the symptoms of colon consciousness at this stage are often absent or so negligible that there is no call on the patient's part for any investigation.

Although diverticula are readily detected by X-ray examination associated areas of intense spasm may simulate a carcinoma or give a distorted picture of the degree of involvement by the diverticula (Fig. 6).

The most common age for surgical intervention in diverticulitis is about 60 years and since that is the average age for carcinoma of the large bowel to occur, difficulties in diagnosis not infrequently arise (Fig. 7). Large doses of belladonna given before the X-ray examination are often of help and recently at the Middlesex Hospital we have used Banthine bromide, the usual dose being 100 mg. given one hour before the examination. We have found the drug to be far superior in its relaxant effect and of great assistance in difficult cases (Figs. 8 and 9).

FIG. 10.—A resection was carried out in this case because small traces of altered blood were found on sigmoidoscopy.

FIG. 11.—Specimen removed reveals a malignant adenoma accounting for the altered blood found on examination.

The surgery for the condition is entirely related to the complications which are in the main primarily the result of superimposed infection. There have been some instances of torsion of an appendix epiploica containing a diverticulum and two cases of perforation of a diverticulum by foreign bodies were recorded as long ago as 1903 by Bland-Sutton. It was not until the break of the present century and for the most part since the First World War that much positive surgery has been employed for diverticulitis. In the early days, although a certain number of resections were performed, the mortality rate was high and drainage for general peritonitis and localized abscesses and colostomy operations were the usual surgical procedures.

This paper has been based upon a study of 59 patients seen in the last few years, 56 of whom were operated upon; all cases of diverticulosis or of mild diverticulitis have been excluded and the clinical material covers most of the usual complications. Of the 3 patients not operated upon, the first was an unfortunate man who developed a pelvic abscess from a ruptured diverticulum nine months after a pneumonectomy for a carcinoma of the bronchus. The abscess happily ruptured spontaneously into the rectum. Another case in the series developed a secondary pelvic abscess *after the establishment of a colostomy* and in this instance drainage into the rectum was assisted surgically. The remaining 2 patients not dealt with by operation were cases of hæmorrhage. In each case the hæmorrhage was profuse, partly altered and quite alarming; both were treated conservatively and with blood transfusions.

Barium enema and sigmoidoscopic examinations revealed extensive involvement of the colon by diverticula but no new growth.

It is probable that these profuse hæmorrhages which are rather unlike the hæmorrhage arising from new growths of the bowel are due to ulceration of some relatively large vessel within the wall of a diverticulum, but it would, of course, be most unwise to assume this without full investigation.

There are in this series 9 other cases of bleeding of a minor character found upon sigmoidoscopy.

The importance of examining the bowel by the sigmoidoscope prior to any bowel preparation cannot be stressed too often and there is no doubt that this bleeding would have been missed had bowel washouts been given.

The discovery of bleeding of this type certainly influenced the decision to operate and in 6 of these cases new growths were found associated with the area of diverticulitis (Figs. 10 and 11).

2 of the cases were carcinomata recognized at laparotomy but in the other 4 adenomata were removed unsuspectingly—2 of which later proved to be malignant.

It is not only difficult for the radiologist to detect tumour formation within an area of diverticulitis but also frequently impossible clinically owing to the dense fibrosis.

In the remaining 3 cases of minor bleeding no tumours were found.

I have on 2 occasions seen small areas of granular mucosa surrounding the openings of diverticula and it is possible that the blood in these cases was coming from such a source.

It would not, however, be safe to assume this since the bulk of the evidence is in favour of there being two conditions when small amounts of blood are seen upon sigmoidoscopy.

Exploratory laparotomy alone was carried out in 4 of the cases because there was doubt about the diagnosis—a small filling defect in association with diverticulosis. In all of these cases only a small area of diverticulosis was found in a rather short sigmoid loop. In 2 of the cases additional confirmation of the diagnosis at the laparotomy was obtained by passing a sigmoidoscope (via the anus) and threading it through the freed loop.

This valuable manœuvre can be very conveniently done if the patient is in the lithotomy-Trendelenburg position and by this method I have reached the iliac colon on several occasions.

In 2 of these cases the great omentum was wrapped round the area of diverticulosis, a manœuvre advocated and frequently practised by J. P. Lockhart-Mummery.

This method may still be used to advantage in cases in which a resection is either not possible or not indicated. The omentum will wall off the area and prevent fistula formation with other hollow organs.

Colostomy

A colostomy is advisable in all those cases with the most serious complications and it is best to place it in the right half of the transverse colon to allow the greatest possible freedom of access when an attempt is made at a later stage to resect the area involved (Figs. 12 and 13). When there is a frank abscess or gross fæcal contamination this should be drained at the time but localized peritonitis will usually respond to treatment with antibiotics.

A colostomy operation was performed for 19 patients in this series, 8 of them still have colostomies and in only 2 of these is a resection being contemplated. There will inevitably be a group of unresectable cases either on account of age or poor risk, or because the colostomy has failed to control the infection. It cannot be assumed that the infection will subside once a colostomy is established. 2 of these patients have had recurrent pelvic abscess and 2 are complicated by a severe procto-colitis and associated chronic pelvic inflammation. Another, who has since had a resection, developed a vesico-colic fistula seven months after the colostomy operation. Presumably the narrow neck of the diverticulum provides inadequate drainage back into the bowel. Some degree of improvement can be obtained in these cases by washing through the distal loop with antibiotic solutions and the usual solution used is 1 gramme of streptomycin in 4 ounces of water. This was found to be very effective in a further case of vesico-colic fistula in which the urinary infection could only be controlled by regular washing through with antibiotics. It is most important that the colostomy should be efficient. When the colostomy has to be permanent or when it is considered necessary to delay the resection for many months it is advisable to separate the proximal and distal limbs with a bridge of skin, the distal opening being made button-size to admit a catheter for irrigation. This will avoid spur retraction and decrease the danger of the colostomy failing to control the infection.

A colostomy in the transverse colon is, of course, a considerable encumbrance, but patients with these colostomies can be made much more comfortable if they are fitted with a celluloid box, like the ileostomy apparatus originally suggested by Corbett (Diagram III).

Rubber apparatus is to be avoided like the plague, and any odour can to some extent be controlled by taking chlorophyll tablets.

Transverse colostomies are apt to prolapse from time to time; should this occur it can be controlled in most instances by wearing a perforated thimble of celluloid over the opening into the box.

It should be generally agreed that once a colostomy has become necessary it is either a permanency or should only be closed after the diseased bowel has been resected. One does, however, hear of cases in which closure is being considered after an interval of time when everything is said to have settled down. There are 4 such cases in the group that I have reviewed, 2 were closed at St. Mark's and 2 elsewhere and this is the story. The first developed a paracolic abscess five months later; the colostomy was re-established at St. Mark's and the patient is now awaiting a resection.

The second died two years later from peritonitis due to a ruptured diverticulum; in the third, the degree of sigmoid stenosis was under-estimated and the closure broke down and the colostomy had to be re-established; this patient has since had a successful resection at St. Mark's. The fourth case was known to be well for three years but has not been traced since.

FIG. 12.

FIG. 13.

FIG. 12.—Demonstrating a badly sited transverse colostomy and also a vesico-colic fistula.

FIG. 13.—Another badly-sited transverse colostomy in which there was fortunately sufficient transverse colon to mobilize.

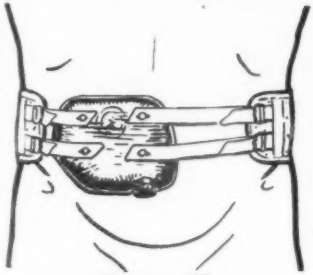

DIAGRAM III.

DIAGRAM III.—A Corbett ileostomy box modified for use with a transverse colostomy.

Diverticulosis being a progressive condition the probability of further troubles is very likely once the stage of diverticulitis has been reached. It would appear to be very unwise to close an established colostomy without resecting the diseased bowel.

Of the remaining cases under review there were 38 resections and 4 combined excisions. The 4 excisions were performed under the impression that an extensive new growth with diverticulitis was being dealt with, the type of case often referred to as a frozen pelvis. They were very difficult dissections and in 2 cases vesico-colic fistulæ were present; 1 of these patients died of shock. In this type of case biopsy evidence is frequently impossible to obtain and barium enema examinations are

inconclusive—revealing the presence of diverticula but querying the nature of a filling defect or area of stenosis.

The situation is not an infrequent occurrence and when in doubt it is wiser to act as one would were the condition definitely neoplastic.

Resections

The decision to operate in cases of diverticulitis *only* is by no means an easy one. It is not the clear-cut issue that faces one in malignant disease. A number will be anxious to be rid of a colostomy which perhaps has been a life-saving measure. In others it may be wise to step in before worse befalls the patient. Each case must be taken on its own merits, and since the disease itself is not necessarily fatal any operative procedure should carry the lowest possible risks.

Of the 38 cases of resection in this series there are 29 sigmoid resections; 7 left hemicolectomies and 2 total colectomies, all of which have done well.

2-*stage operations*.—8 of these cases had preliminary colostomies, and, as already mentioned, these had the most severe complications. They include the vesico-colic fistulæ and paracolic abscesses with abdominal-wall fistulæ and the chronic pelvic abscesses and the strictures with acute obstruction.

The two total colectomies with ileo-rectal anastomosis require some explanation since it is not the usual remedy in this condition nor is it frequently necessary or advisable. The first had a stricture of the pelvic colon with multiple diverticula up to the transverse colostomy and also involvement of the upper rectum. The left colon was unsuitable to bring down to the shortened rectum and the mesentery of the right colon too short to allow an anastomosis.

In the second case, an excision of the sigmoid by Hartmann's operation had been performed elsewhere, the patient then developed a low-grade colitis for which an ileostomy had been done. The whole colon was found to be involved by diverticula coupled with a low-grade colitis and it was on account of the two conditions that a total excision of the colon was made and the ileum anastomosed to the rectal stump.

In all, 4 cases were complicated by a procto-colitis, in 2 the colitis appeared to be a separate entity whilst in the others it may have been an inflammatory state of the mucous membrane produced by the diverticulitis. The colitis symptoms unfortunately masked a carcinoma of the colon in 1 case, and at laparotomy there was very extensive peritoneal spread.

A resection in these severely complicated cases is usually a very difficult and tedious procedure and many patients will be found to be physically unsuited for it. Owing to the solid fibrosis that develops, the dissection and freeing of the involved bowel is infinitely more formidable than that in most carcinoma cases, but occasionally things are far easier than one anticipates.

Especial precautions must be taken with regard to the ureters and their isolation commenced at the earliest possible stage in the operation. Preliminary catheterization of both ureters is frequently of value and an additional safeguard.

It is often quite impossible to lift or resect the meso-colon and under these circumstances the bowel can be cut away from its mesentery, picking up the sigmoid vessels one by one as they are divided. Full mobilization of the left half of the transverse colon and splenic flexure will frequently be necessary to obtain sufficient bowel for the anastomosis. Twenty-five years ago Pauchet at a meeting of this Section advocated the insertion of a portion of small intestine to fill the gap when insufficient colon was available, and there are records of this manœuvre having been carried out successfully on a number of occasions. When a bladder fistula is present the rift made by removing the indurated tissue may be quite considerable. It requires careful suturing and I have always applied a continuous suction drainage through an indwelling catheter for seven to ten days after the operation.

However, despite the laborious and sometimes Herculean nature of these operations the results have been most gratifying.

In most of these cases the colostomies had been performed elsewhere, often years before, and a resection executed at a much earlier stage would probably be considerably easier. There would probably be less dense fibrosis, and the tissue planes would separate more readily and now that we have the advantages of all the antibiotics it should be as safe. This view is based upon experiences in the last group of cases, the 30 single-stage resections.

It will be remembered that in this group the complications were by no means so severe, but there were cases of inflammatory obliteration of the pelvis, early small pelvic abscess formation and mesenteric and pericolic abscesses; but the tendency has been to operate before severe complications have supervened.

These cases tend to fall into three main groups. Approximately one-third had had recurrent severe left iliac fossa pain, the majority being accompanied by fever. Frequently a palpable tumour was present.

Although these acute attacks will usually subside by administering sulphonamides and antibiotics there is a considerable risk of some further complication developing at a later stage. Where the patient is otherwise fit and suitable for operation an early resection is the safest course.

The remaining two-thirds of the cases had symptoms of chronic obstruction and in one-half of these there was some pre-operative doubt as to whether a new growth might be present as well. The uncertainty arose either on account of bleeding as seen on sigmoidoscopy (and, as already mentioned, 6 out of 9 had tumours), or because a palpable mass was found and the radiologist was unable to exclude a carcinoma owing to the distortion caused by the diverticulitis.

In several there have been attacks of subacute obstruction relieved medically.

The X-ray appearances in 3 cases suggested a paracolic abscess but the distortion proved to be due to kinking of the bowel by extensive fibrosis in the mesentery (Figs. 14 and 15).

FIG. 14.—Bowel distortion due to extensive mesenteritis.

FIG. 15.—Specimen showing mesenteritis.

Except for six Paul-Mikulicz operations, mostly performed earlier on in the series, the remaining resections were completed by a two-layered end-to-end anastomosis—full bowel preparation with sulphonamides and antibiotics being given beforehand. The site of the anastomosis was drained retroperitoneally in each case; intraperitoneal drainage leads to an increased incidence of post-operative small bowel obstructions.

The results in these cases have been most satisfactory there being a complete relief of symptoms and in the majority a restoration of normal bowel habit; though some have a little frequency of action due to the shortened colon.

In conclusion, I would like to stress these points:

(1) The value of Banthine bromide in X-ray diagnosis.

(2) The value of sigmoidoscopic examination prior to any bowel preparation, and the significance of minor bleeding, and its value at laparotomy, in the obscure case.

(3) The danger of colostomy closure without resection.

(4) The need for earlier resection in carefully selected cases before severe complications occur, and earlier resection in those cases where a preliminary colostomy has been necessary.

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[*January* 14, 1953]

Demonstration

Replica of B.M.A. Demonstration Booth on Carcinoma of the Colon.—Mr. LAWRENCE ABEL.

The Following Cases and Specimens were Shown

Fibre Sarcoma Arising from Lumbo-Sacral Cord Presenting with Rectal Symptoms.—Mr. E. C. B. BUTLER.

Hæmangeioma of the Rectum.—Mr. G. RAMSAY.

Leiomyosarcoma of the Rectum.—Mr. P. G. SOMERVILLE.

Suppurative Hidradenitis of the Perineum Showing Malignant Changes.—Mr. H. J. HAMBURY (for Mr. S. H. WASS).

(1) Cæcal Bladder. (2) Ulcerative Colitis Treated by Subtotal Colectomy and Ileorectal Anastomosis. (3) Ulcerative Colitis Treated by Left Hemicolectomy and Colorectal Anastomosis.—Mr. H. R. THOMPSON.

Ileal Bladder.—Mr. M. R. EWING.

Multiple Carcinomata Associated with Polyposis of the Colon.—Mr. D. V. EVANS (for Mr. E. C. B. BUTLER).

(1) Diverticulitis of the Cæcum. (2) Carcinoma of the Cæcum with Multiple Polyps.—Mr. R. H. GARDINER.

Diverticulitis of Pelvic Colon with Large Solitary Diverticulum.—Mr. W. B. GABRIEL.

Giant Diverticulum of the Colon.—Mr. A. EMLYN WILLIAMS.

Extensive Polyposis of the Colon from a Patient with Dormant Amœbic Dysentery.—Mr. E. W. GRAHAME.

Portion of Transverse Colon Showing Adenomatous Polyposis.—Mr. R. CORBETT.

Subtotal Colectomy in a Case of Fulminating Ulcerative Colitis with Perforation.—Mr. STANLEY AYLETT.

Section of Anæsthetics

President—M. D. Nosworthy, M.A., M.D.

[*December* 5, 1952]

DISCUSSION ON ANÆSTHESIA IN CARDIAC DISEASE

Dr. E. H. Rink (Department of Anæsthetics, Guy's Hospital): Comparatively few anæsthetists have to deal with cardiac surgery, but any of us may be called upon to anæsthetize a cardiac patient for some other operation, and must be able to give a reasoned opinion as to whether the proposed procedure is, or is not, feasible. We believe that our experience of heart surgery has given us some guidance on these problems. It has certainly taught us a great deal about how to handle cases of severe heart disease.

Anæsthetists have long recognized that it is cardiac function which matters, not lesions and not murmurs. A patient may, for example, be suffering from well-established mitral stenosis, he may even be fibrillating, but if he can lead anything approaching a normal life and do even light, regular work, he should be a quite reasonable anæsthetic risk if properly handled. But if he has broken down at his work, or in the case of a woman, if she is unable to run her home, then the dividing line has been crossed and the risk has become a more serious one. In the case of a completely bedridden patient, it is naturally even worse, but still appears to be not quite so bad as was once thought. It is becoming almost a commonplace to say how surprisingly well even a diseased heart stands surgical trauma. But it is really equally surprising how well it stands the strain of anæsthesia.

The behaviour of a typical, severe case of mitral stenosis undergoing valvotomy may be taken as an example. She was a woman of 54 and had been confined to bed for a year; she was fibrillating, and had had emboli, she also suffered from severe attacks of cardiac asthma. The systolic blood pressure at the beginning of the operation was 110 mm. of mercury. After the pericardium was opened it dropped to 70 mm. After the actual valvotomy, during which it was very low, it recovered fairly rapidly and was above its pre-operative level by the time she left the theatre. In very few cases does the blood pressure fall markedly until the pleura and pericardium are opened.

One has therefore to consider what these patients could stand in the way of other surgery, if it were necessary. I feel quite confident that one could safely anæsthetize them for comparatively minor surgery. In my opinion no patient should be refused anæsthesia on account of his cardiac condition alone unless he is in a state of gross failure, which will not respond to efficient treatment. Sometimes, of course, one's hand is forced, as happened a short time ago at Guy's Hospital, when one of my young colleagues had to anæsthetize a woman in labour who was in a state of congestive failure with œdema from mitral stenosis. This he was able to do successfully, rather, I think, to his own surprise, by following the principles which we are going to suggest.

The points which will most strongly suggest caution are very severe disability, gross cardiac enlargement, congestive heart failure and pulmonary œdema, or a degree of pulmonary congestion likely to lead to it. This last condition has proved to be far more common and important, especially in connexion with mitral stenosis, than we had previously thought, and it is essential for an anæsthetist to know not only how to deal with an established attack but also how to prevent one by effective prophylaxis.

Usually there is no difficulty about recognizing that the patient is suffering from heart disease; the anæsthetist will probably have been told about it in advance and the patient will be only too anxious to warn him. The greatest danger lies in unsuspected heart disease, particularly in coronary artery disease during and after middle age, and particularly when the anæsthesia is to be conducted in an out-patient department. Indeed I think it should be laid down as a principle that the patient should not be anæsthetized as an out-patient. Two cautionary tales illustrate these points. In the first, a man of 5[illegible] developed primary heart failure after the extraction of one tooth in the dental chair. He was being given nitrous oxide and oxygen by a highly competent Registrar, who was unable to resuscitate

him by the usual methods. At autopsy, his coronary arteries were found to be tortuous and narrowed and this was considered by the pathologist to be the cause of death. But the interesting thing was that his wife could not recall any symptoms which might have suggested that, and it is difficult to see how possibly similar cases might be detected. I understand that even routine electrocardiography would not necessarily give the required information. But if this man had been able to give a history of even one previous attack of coronary occlusion, he would have been anæsthetized by some other method and might well have been alive to-day. Questioning of patients in middle age concerning the existence of precordial pain and nocturnal dyspnœa may yield valuable and warning information. The moral of this story is that for patients with coronary heart disease, unpremedicated dental gas even in good hands is dangerous, by reason of the hypoxyia which it entails.

The second story concerns another out-patient, a man in the middle 60's who was known to be suffering from myocardial disease, and who had an axillary abscess which required incision. An intelligent but inexperienced resident anæsthetist observed that he was somewhat dyspnœic, but thought that safety would be sufficiently served if he mixed 1 ml. of nikethamide with 0·5 gramme thiopentone. This he injected fairly slowly in divided doses, but he did not realize that in such a patient the peripheral circulation would be considerably slower than normal. He had therefore injected his full 0·5 gramme before the patient had lost consciousness; a moment later the patient collapsed, clearly with circulatory failure, resuscitation was unavailing and he died. This obviously was a case of mismanagement due to inexperience. The patient should have been admitted to hospital and not anæsthetized until he had had a few hours of rest in bed. He should then have been well premedicated, after which a minimal dose of thiopentone followed by cyclopropane would have been safe and adequate. Similar deaths due really to inadequate appreciation of the dangers involved must be moderately frequent.

First principle to be observed in the presence of heart disease is the necessity for adequate oxygenation, and this implies two different processes. Firstly, the patient must receive considerably more oxygen than is contained in the atmosphere, and the worse the cardiac condition the greater the percentage of oxygen must be in the inspired mixture. Therefore nitrous oxygen should play little, if any, part in anæsthesia for really severe cases of heart disease. Secondly, the patient's oxygen requirements should be diminished by adequate premedication and the establishment of metabolic conditions as close as possible to basal. The importance of the latter is well illustrated by the behaviour under anæsthesia of the subjects of cyanotic heart disease. In these, the colour invariably improves as anæsthesia is established and the improvement is far greater than can be obtained by giving oxygen when they are conscious. The establishment of near basal conditions implies the abolition of all movement of voluntary muscles, that is to say, controlled respiration should be used for all except very short anæsthesia.

Premedication

The old view that the use of depressant drugs should always be avoided in the presence of heart disease is quite wrong. Rather is it essential that emotional disturbances should be minimal, as these may precipitate an attack of angina in patients with coronary disease, or pulmonary œdema in patients with mitral stenosis. Therefore even after ample premedication it is necessary to induce anæsthesia by the intravenous rather than the inhalational route. I know of one case, not in this country, in which pulmonary œdema actually developed during induction with cyclopropane Naturally the dosage of such drugs as thiopentone should be kept as small as possible, as it is in fact the case that cardiac patients need smaller doses of all anæsthetic drugs than do healthy individuals. In order to avoid hypoxyia during administration, it is altogether essential to avoid any form or degree of respiratory obstruction; the most important single step to this end is preliminary topical anæsthetization of the larynx, and by this I do not mean a perfunctory spraying of the pharynx. I personally achieve it by the application of 2% butyn over the back of the tongue with a laryngeal cannula, preceded by the sucking of a lozenge containing 50 mg. amethocaine. Naturally it does not matter exactly how it is done provided that the topical anæsthetization is efficient, that is to say, that it should be possible to intubate a patient with that alone, although naturally one would not wish to do so. But if it is done properly, it is then possible to intubate with minimal doses of thiopentone, of which I seldom need to use more than 300 mg. in these patients. If it is not considered necessary to intubate in a particular case, anæsthetization of the larynx is even more useful as it abolishes all possibility of laryngeal spasm, and in itself almost completely ensures a smooth administration. I regard it as the most important single practical step in anæsthetizing bad risk cases, and I think it makes for safer and smoother induction than does the use of relaxants, which I prefer to keep for later on in the proceedings. After the avoidance of anoxia, I believe that the next most important point is the preservation of an adequate blood pressure. Cardiac patients have very little ability to increase their cardiac output in response to peripheral vasodilatation, and they stand fall of blood pressure badly. It is, I think, very easy to see how readily this may lead to coronary or cerebral insufficiency. Neither do cardiac cases have a very good peripheral circulation, and therefore all drugs which are given intravenously will take longer to act and will be eliminated more slowly. They must therefore be used with great caution, and given slowly.

Cardiac Asthma

Cardiac asthma must be distinguished from bronchial asthma. A man in his early 40's with severe mitral stenosis and frequent attacks of cardiac asthma was suffering from a dental cyst, and a very junior resident anæsthetist was asked to anæsthetize him. The resident regarded him as suffering from bronchial asthma, and with the best of motives, but with completely faulty reasoning made almost every possible mistake. He gave the patient very little premedication—in fact only 1/100 grain (0·6 mg.) atropine and did not cocainize the larynx. He had read that thiopentone and cyclopropane are bad for asthmatics, so he attempted to induce with nitrous oxide and oxygen and ether, preparatory to intubation. Long before the patient was ready for this, he was becoming cyanotic and bubbly and soon his pulse began to deteriorate. Injection of adrenaline improved the situation temporarily, but soon again it proved impossible to maintain a good colour although the oxygen in the mixture was increased. At this point it was decided to abandon the attempt, and the patient was put back to bed and given pure oxygen. He escaped with his life, but I think he was lucky to do so. The proper way to handle this patient would have been to give him aminophylline pre-operatively combined with fluid and salt restriction for a few days. He should have had far more premedication, probably Omonopon 1/3 grain (20 mg.) and scopolamine 1/150 grain (0·4 mg.), and had his larynx anæsthetized. He could then easily have been intubated with a small dose of thiopentone and all would probably have been well. Further bronchial activity would have been most unlikely; had it occurred, 250 mg. of aminophylline intravenously and bronchial suction would have been the correct treatment.

I have only had time to run most briefly over the salient features of this subject. The recent development of cardiac surgery has shown us far greater possibilities of being able to anæsthetize sufferers from heart disease for all sorts of conditions.

Dr. A. M. Hutton (Department of Anæsthetics, Guy's Hospital): I propose to mention a few points in anæsthetic technique which are applicable to any patient with severe heart disease, undergoing an operation.

Premedication in Adult Patients

In ordinary cases, poor premedication will not affect the ultimate success of the anæsthesia or operative procedure, although it may make induction more difficult for the anæsthetist, but cardiac patients in general, and particularly those suffering from a severe degree of mitral stenosis, require exact and adequate premedication or the hazards of anæsthesia and operative interference may be seriously increased.

Hitherto patients were given too little morphia before operation. Our early cases were lightly premedicated with 1/6 grain (10 mg.) morphia in combination with 1/100 grain (0·6 mg.) of atropine one hour prior to operation. Emphasis was laid on the appalling danger of depressing, even to a slight degree, the respiratory centre of any patient suffering from dyspnœa on the slightest exertion. I think that it is time for this bogy to be exorcized. Depression of the respiratory centre, which may be caused by full premedication, can easily be compensated for by the administration of oxygen with a B.L.B. mask. An important point in the pre-operative preparation of the patients is to make them so familiar with oxygen therapy that it no longer perturbs them to wear a B.L.B. mask or to see an oxygen tent.

Most adult sufferers from severe valvular disease of the heart are aware that they are handicapped as compared to a normal individual. The more severe the lesion, and the greater the degree of incapacity, the more certainly that statement applies. As a result, an intelligent patient will appreciate full well that his very existence is hazardous; hence it is not surprising that this type of patient is apprehensive when called upon to face an operative procedure. Many fears and worries can be allayed by the physician, surgeon and anæsthetist if they obtain the patient's confidence prior to operation and give him some reassurance. Sometimes, however, this is easier said than done. My classical case in this connexion, was the man who appeared for mitral valvotomy and who had been told by his doctor many years previously that he should never have a general anæsthetic for any operation, as it would be dangerous for him because of the state of his heart!

After premedication with a full dose of morphia the general condition of these patients often improves remarkably. This improvement is due to the lowering of the metabolic rate and hence of the patient's oxygen requirements and thus the burden on the heart is lessened.

The picture is very different in the under-premedicated patient who arrives in the anæsthetic room, worried and anxious, with an increased pulse-rate and rapid respiration. An average normal adult weighs about 10 st. (63 kg.). Adequate premedication for this type of patient would be Omnopon 1/3 grain (20 mg.) and scopolamine 1/150 grain (0·4 mg.) one and a half hours before induction of anæsthesia, but a highly nervous man of 13 st. (82 kg.) weight would require morphia 1/4 grain (16 mg.) or Omnopon 2/3 grain (40 mg.) to sedate him adequately.

In a similar fashion the dosage of morphia or Omnopon must be varied for the cardiac patients and they should be given the full amount which would be considered necessary if one was dealing with a normal subject. Apart from the immediate pre-operative premedication, we try to obtain a good night's sleep for these cases prior to their operation by means of a barbiturate usually Seconal 3 grains

(180 mg.) given by mouth. If the operation happens to be in the afternoon, the patient is also given Seconal shortly after awakening in an endeavour to keep him quiet during the morning and, in the mitral cases, to help prevent the onset of pulmonary œdema. For the same reason, the severe mitral cases receive 0·25 gramme aminophylline intramuscularly with their Seconal and their premedication.

All cardiac patients are weighed prior to operation as body weight is a useful guide not only to the amount of premedication required but also to the amount of intravenous drugs, such as procaine, pethidine or thiopentone, which will be needed during maintenance. In this connexion allowance must be made for gross œdema and pregnancy. Oxygen must be continually available for these patients; we have one oxygen cylinder and B.L.B. mask by their beds and another which can be strapped on to the trolley which takes them to the theatre, so that if necessary they can inhale oxygen until anæsthesia is commenced.

The majority of the cases of mitral stenosis which are sent for operation are verging on pulmonary œdema and very little disturbance may precipitate an acute attack. Sudden movement must be avoided and an orthopnœic patient should not be laid flat but should be brought to the anæsthetic room propped up with his usual number of pillows.

Nursing staffs are so accustomed to sending patients to the operating theatre with only one pillow on the trolley that they may not consider the patient's condition. As an illustration, one of our early cases of severe mitral stenosis had been considerably improved, but by no means made perfect, by valvotomy. Some months later she was readmitted to a different ward at Guy's for tonsillectomy. By sheer chance one of our physicians visited her after she had been premedicated just before she was due to go to the operating theatre. He found her in considerable distress, lying almost flat in bed with only one pillow.

It has been noticed in several patients that psychological disturbances immediately prior to cardiac catheterization have brought on pulmonary œdema. The mental trauma and disturbances just before operation are much more serious. I have had one patient who developed a severe attack of pulmonary œdema immediately he arrived in the anæsthetic room. There have been others. These patients required immediate and vigorous treatment in order to save their lives but there have been several others in milder degrees. Even a mild degree of pulmonary œdema adds to the difficulty and danger of anæsthesia because these patients are more difficult to inflate as all the fluid cannot be removed by suction. Herein lies the great danger of underpremedication with morphia.

The treatment of an acute attack of pulmonary œdema (Baker *et al.*, 1952) is to prop the patient upright on the trolley with his legs hanging down over its sides, and give him oxygen. Without delay venous tourniquets should be applied as high as possible on each thigh, in order to diminish the venous return, and 0·25 gramme of aminophylline slowly injected intravenously. A bronchoscope and a suction catheter must be kept at hand, as unless the patient's condition improves rapidly with these measures it will probably become necessary to suck out his bronchial tree. If there is no immediate improvement with this treatment venesection of 500 ml. should be done.

Premedication in Children

The vast majority of cardiac children are suffering from either some form of congenital pulmonary stenosis or patent ductus. Their actual cardiac lesion is immaterial from the point of view of premedication. They should be given full basal narcosis in bed in the ward, either by means of rectal Pentothal or by oral Nembutal (Rink *et al.*, 1948). The dosage is entirely by body weight and is the same as for normal children. My own choice is for rectal Pentothal as in my hands it is more certain in its action.

We also premedicate these children with atropine 1/100 grain (0·6 mg.) half an hour before they are due to arrive in the anæsthetic room. In some of the literature I have read atropine has either been eliminated from the premedication or given in almost homœopathic dosage in cardiac surgery, in an attempt to prevent tachycardia (Pender, 1953). Under the light anæsthesia used in these cases, particularly if it is a nitrous oxide, oxygen, pethidine, procaine, curare sequence, I think that atropine is of considerable value in obtunding vagal reflexes and may be an aid in the prevention of arrhythmias. In fact, I have on several occasions in adult patients, injected 1/200 grain (0·3 mg.) intravenously during the operative procedure in order to correct an arrhythmia—it sometimes seems to be successful. Furthermore I have never seen any ill-effects following the administration of intravenous atropine prior to the use of Prostigmine at the end of a cardiac operation.

Induction and Maintenance

All adult patients, except cases of severe constrictive pericarditis, are induced by means of intravenous thiopentone after the application of a local anæsthetic agent to the cords. As Dr. Rink has stated the dose of thiopentone is very small. I believe that all cardiac patients who are undergoing major operations should be intubated with a cuffed tube, as a perfectly clear airway must be assured at all times and intermittent suction may be necessary. In addition, as some relaxant drug will almost certainly be given to the patients, it may easily become essential to control their respirations in order to ensure an adequate ventilation of the lungs.

For small operations of short duration when it is unnecessary to control respiration, the addition of an ampoule of nikethamide to the 0·5 gramme of thiopentone in the syringe is some help in preventing undue respiratory depression and excessive fall in blood pressure. In this type of case it is an additional safeguard to use a 0·25% solution of thiopentone instead of the usual 0·5%.

In my opinion, when dealing with patients whose cardiac lesions are giving rise to any symptoms whatsoever, there is no such thing as a minor operation. Obviously the size of the operation and the time required for its completion will be of the greatest significance in considering the patient's chance of survival, but in dealing with this type of individual every anæsthetic should be regarded as of major importance even if the actual operation will only last a few minutes.

The Electrocardiogram.—A pre-operative electrocardiogram is of great value to the anæsthetist, inasmuch as it gives him an indication of possible dangers. For example the ECG tracing may reveal that the patient is suffering from coronary disease, a fact which might otherwise be missed. We also have a continuous ECG recording during our cardiac operations. At operation, however, I am a little disappointed in the value of the ECG in assessing the condition of the patient. In giving an opinion on the state of the patient during operation, I believe that the anæsthetist should answer according to his own clinical judgment paying attention to changes in the rate and tension of the pulse if he can feel it, in the blood pressure if he can record it and in the appearance of the heart beat if he can see it, rather than to rely on changes in the ECG tracing.

It is very pleasant to have a continuous ECG recording with expert interpretation during these operations as a confirmation of one's clinical findings. I have never had a patient whose condition I thought was satisfactory and the ECG expert thought otherwise but on several occasions when clinically the patient had deteriorated very considerably, the ECG showed little or no change.

In my opinion an electrocardiographic tracing during operation on a case of heart disease, is by no means a necessity, but it should be regarded as a useful aid to one's clinical judgment.

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Assessment of the Anæsthetic Risk

This type of patient can be roughly assessed both for the operative and the anæsthetic risk on the anatomical lesion that is present. There is no doubt that the patients who have an obstruction to the ventricular outflow—for example cases of pure pulmonary valvular stenosis or aortic stenosis—present a much worse risk than those who suffer from the tetralogy of Fallot or mitral stenosis. Cases of aortic incompetence probably give rise to the greatest anxiety of all.

A more accurate assessment is made from the following observations:

(1) The degree of disability.

(2) The size of the heart.

(3) A history of long-standing auricular fibrillation.

(4) The presence (or previous history) of right or left-sided heart failure with particular reference to pleural effusion or ascites.

(5) Infection of the bronchial tree—especially if associated with some degree of bronchospasm.

In adults it is on this assessment, in my opinion, that both the dose of premedication to be given and the method of induction to be employed depend. The premedication for children has already been dealt with by Dr. Hutton.

Premedication, Induction and Maintenance of Anæsthesia

In the past mitral valvotomy was performed only on very poor risks. The present tendency, however, is to operate on patients with only a moderate degree of disability, and in the future, no doubt this tendency will be carried even further. In this last type of patient, the anæsthetist could use the same method of premedication, induction and maintenance of anæsthesia as he would for any thoracotomy in a relatively fit patient.

Although heavy premedication is desirable if laryngeal analgesia is to be obtained before induction, I, myself, prefer lighter premedication with the postponement of the production of laryngeal analgesia until induction has been completed. Therefore in the poor risk patient, I prefer atropine 1/100 grain (0·6 mg.) to scopolamine 1/150 grain (0·4 mg.) associated with Omnopon 1/3 grain (20 mg.) or 1/6 grain (10 mg.) depending upon the patient's physical and mental state. Anæsthesia is then induced with a sleep dose of thiopentone given slowly, followed by cyclopropane with the very gradual introduction of ether until an adequate depth of anæsthesia for endotracheal intubation has been obtained.

(Induction with thiopentone and a relaxant is to be condemned, because in this type of case the fall in blood pressure and apnœa which occurs may prove fatal.) But immediately prior to intubation the vocal cords are sprayed under direct vision with Xylocaine 4% or cocaine 10%. Once intubation has been smoothly carried out anæsthesia can be maintained by any anæsthetic agent of the anæsthetist's choice. This choice will be influenced by:

(1) The surgeon's desire to use diathermy.

(2) The necessity for a rapid recovery of consciousness.

The former makes it essential to use a non-explosive mixture. The latter is necessary so that on return to the ward the patient can, as soon as possible, be placed in a sitting position in an oxygen tent. Here it should be pointed out that the patient should wear a B.L.B. mask for the first hour in the tent—that is until the concentration of oxygen in the tent has reached its maximum. A rapid return to consciousness is also desirable so that any embolic phenomena can be observed. For example, if there is delayed recovery of consciousness a cerebral embolism may be suspected. On the other hand if the patient regains consciousness rapidly the diagnosis of a peripheral embolism may be made and embolectomy performed. This is well illustrated by the following case. A man, aged 39, who had undergone mitral valvotomy, complained bitterly of severe pain in both legs during the application of the dressings. Neither femoral pulse could be palpated and a diagnosis of an embolus at the aortic bifurcation involving both common iliac arteries was made. Without leaving the operating table the patient was re-anæsthetized and a successful embolectomy carried out with the removal of a Y-shaped clot. In spite of a good post-operative recovery, unfortunately a cerebral embolus occurred thirty-six hours later resulting in almost immediate death.

Before passing on to the consideration of the drugs used in cardiac surgery, it should be strongly emphasized that there must be no unnecessary delay between the completion of induction of anæsthesia and the relief of the cardiac defect. It is during this period that the patient tends to go downhill—particularly if it is prolonged.

Drugs

I shall discuss only such drugs as are specifically related to this type of work. First of all we must deal with the pre-operative use of digitalis and quinidine—aminophylline having already been mentioned by both Dr. Rink and Dr. Hutton. Originally we gave both digitalis and quinidine, but more recently we have given up the use of the latter for the following reasons. Quinidine in a dosage of 5 mg. t.d.s. fails to control arrhythmias and in higher dosage gives rise to toxic manifestations. Also after the use of quinidine, post-operative cardiac irregularities may change into an auricular flutter. So that now a pre-operative course of digoxin alone is given. This course lasts five days—the first day 1 mg. t.d.s., the second day 0·5 mg. t.d.s., and the remaining three days 0·25 mg. t.d.s. Under this régime if auricular fibrillation should occur it is of a slow rate and well controlled.

The drugs used during operation to control cardiac arrhythmias are procaine hydrochloride and procaine amide. The latter, in the few cases in which it has been used, has been unpopular because of the difficulty of controlling the dosage and the danger of a cumulative effect. Procaine hydrochloride, on the other hand, is easy to control and has been used as a 0·2% or 0·4% intravenous infusion with an average dose of 1 gramme per hour, in a patient of 150 lb. (68·05 kg.) body weight. But even in this dosage a careful check must be kept on the patient's blood pressure. It seems unnecessary to use procaine in mitral valvotomies, but it should always be used in ventricular cardotomies.

The only other drugs used during operation are the vasopressor group, of which Methedrine is found to be the most useful. But the rapid rate and forceful contractions of the heart produced by Methedrine contra-indicate its use—unless absolutely essential—before the surgeon has completed the cardiac part of the operation. Care should be taken to avoid too large a dose; 5 mg. is usually quite adequate and can always be repeated if there is no response within three to five minutes of the initial dose. Normally the intravenous route is satisfactory but in an emergency it is best given by intracardiac puncture. Noradrenaline is not considered a suitable vasopressor drug for cardiac surgery because its main action is to cause contractions of the arterioles, thus making the heart work against an increased peripheral resistance. It may, however, be useful in cases of aortic incompetence where the blood pressure on no account must be allowed to fall at any time.

Fluid Balance

In some cases during cardiac operations sudden heavy loss of blood may occur; in others—particularly those with right-sided heart failure or a tendency to pulmonary œdema—the circulation can be easily overloaded. It is important, therefore, that a fairly accurate fluid balance should be maintained. To this end it is better to check the visual observation of the blood loss in the following manner. The difference in weight in grammes between the dry and the blood-soaked swabs gives the blood loss (on the swabs) in millilitres. To this is added the volume of blood in the sucker; thus an approximate estimate of the total blood loss is obtained.

As a general rule blood loss should be replaced by blood, but in cases of cyanotic congenital heart

disease, where the hæmoglobin percentage may vary from 110 to 140% it is probably better to replace small quantities of blood loss by gum-saline or dextran.

In cases of severe mitral stenosis, where there may be a danger of pulmonary œdema, it is essential to give a low sodium diet and to restrict fluids for a few days pre-operatively. In all patients, who are liable to cardiac failure, normal saline should never be used for intravenous infusion. Dextrose 4% in N/5 saline can be used, but even then only sparingly. If procaine hydrochloride is to be given it should be made up in dextrose 5% and distilled water.

Treatment of Cardiac Arrest (In Cardiac Surgery)

Under this heading is included the condition of ventricular fibrillation. In cardiac arrest the most important factor is to maintain an adequate cerebral and coronary circulation. With this in mind the following routine is suggested for the surgeon and the anæsthetist:

(1) Relieve the obstructed chamber if possible; at the same time give 100% oxygen and artificial respiration.

(2) Maintain the circulation by cardiac massage and prepare for arterial transfusion. (It should be noted that this can be given into the aorta.)

(3) Give 5 ml. of 1% procaine hydrochloride into the left atrium.

(4) If ventricular fibrillation appears to be present or is demonstrated by the electrocardiogram, give further procaine and use a defibrillator if available.

(5) If still no improvement give 2–10 ml. of 10% calcium chloride to increase ventricular contractions.

(6) And lastly, give ½ to 1 ml. of 1 in 1,000 adrenaline.

I should like to stress that efficient cardiac massage is the most important factor of all.

Anæsthesia for Diagnostic Procedures

Cardiac catheterization, and angiocardiography in particular, must not be treated as minor procedures in patients who, in many cases, are seriously ill.

Cardiac catheterization in older children and adults is carried out under local analgesia. In young children it is best performed under basal narcosis with rectal thiopentone in association with local analgesia for the exposure of the vein. If the basal narcosis is inadequate it can be supplemented with very small doses of thiopentone either intravenously or through the catheter after it has been introduced into the vein. Inhalational agents are contra-indicated because they interfere with the blood oxygen estimations.

In angiocardiography the most suitable premedication for the older patient is pentobarbitone and atropine, and for the younger child rectal thiopentone and atropine. Quinidine and a test dose of diodone (in the form of a tablet) used to be given pre-operatively. But now neither is given. Quinidine is omitted because in angiocardiography it is not arrythmia, but cardiac depression which may occur. Instead of a diodone tablet given pre-operatively, 0·1 ml. and then 1 ml. of diodone is now given intravenously as a test dose at the time of the investigation and a check made on ECG changes. This is followed by a quantity of saline slightly larger than that of the estimated dose of diodone to be given. If none of these produce ECG changes or a fall in blood pressure then the injection of diodone may be made. The anæsthetic of choice for children under 10 years of age is cyclopropane, ether and oxygen through a cuffed endotracheal tube. Older children and adults require local analgesia only. Intravenous procaine both before and after the injection of diodone is not essential but may be used provided it causes no fall in blood pressure. The danger period in these cases is the fifteen minutes following the injection of the drug, and throughout this time the patient must be carefully watched—particularly for any fall in blood pressure—and on return to the ward must spend the first three to twelve hours in an oxygen tent. During this period sedation is essential if the patient should become restless, as this may cause an alarming degree of deterioration if left unchecked.

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Dr. I. W. Magill described an operation under refrigeration anæsthesia which he had seen recently at the Hahnemann Hospital, Philadelphia. C. P. Bailey performed the operation. Ken Keown was the anæsthetist.

The patient aged 7 months was premedicated with atropine and intubated under cyclopropane. The child was then completely covered with a thin mattress composed of closely approximated rubber tubing through which iced water was circulated by means of an electrically-driven pump.

A saline drip was set up and leads attached to an electrocardiograph. After one and a half hours the rectal temperature had fallen to 71° F. No further anæsthetic was required after intubation and respiration was controlled.

A transverse incision was made along the lower border of the pectoralis major muscles and the pericardium opened. It was then possible to diagnose the condition as transposition of the aorta and the pulmonary artery.

The superior and inferior venæ cavæ were then occluded by temporary ligatures. Aorta and pulmonary artery were divided between clamps and sutured in normal position, a procedure which required twenty-one minutes. During this time the heart continued to beat at a rate of 4 to 5 per minute. After removal of the clamps and temporary ligatures circulation was stimulated by an injection of neosynephrin into the wall of the left ventricle and by the surgeon flicking the apex with his finger.

After closure of the wound temperature was gradually restored to normal. Two hours after the end of the operation the child cried lustily and was taking feeds by mouth after four hours.

Dr. W. D. Wylie said that most speakers had stressed that cardiac decompensation could follow the sudden production of peripheral vasodilatation in mitral stenosis. However, the onset of pulmonary œdema might be an indication for the deliberate production of such vascular dilatation as a form of internal venesection. It could be produced by certain forms of local analgesia or the use of methonium compounds.

Dr. John Beard said that he believed a good way to deal with a bad cardiac case was to induce it in bed, after heavy premedication of one sort or another. By doing this the occurrence of tachycardia or pulmonary œdema was less likely. He himself made a routine of inducing all cardiac cases in that way. It was not necessary for mild ones, but for more severe cases it would probably make a very real difference.

Dr. H. C. Churchill-Davidson said that in a severe case of mitral stenosis an increase in cardiac output must necessarily be limited by the degree of the valvular lesion. Such cases showed marked peripheral vasoconstriction in the extremities, but the induction of anæsthesia led to dilatation of the skin- and muscle-vessels, often resulting in a fall in blood pressure. This increase in blood flow through the skin was sometimes erroneously taken as a sign that the circulatory condition of the patient had improved following the commencement of anæsthesia. During mitral valvulotomy, it was important to maintain a reasonable level of blood pressure in order to ensure an adequate blood supply to the brain and the heart. In the event of a sudden fall in blood pressure it would seem rational to use a pressor drug which acted by peripheral vasoconstriction (l-noradrenaline) and not one that increased the cardiac output (desoxyephedrine) and thus added to the risk of cardiac arrhythmias. Weight was given to this argument by the case described by Dr. Rink, in which three injections of desoxyephedrine (Methedrine) had failed to produce a rise in blood pressure.

In the acute circulatory collapse that might follow an injection of thiopentone he believed that the prompt use of l-noradrenaline might prevent a fatal outcome. He recalled one patient into whose jugular vein he had injected 200 microgrammes noradrenaline; the immediate response was a rise in blood pressure to 300/150 mm.Hg (showing that the dose was excessive), and the final response recovery of the patient.

Section of Pædiatrics

President—D. W. WINNICOTT, M.A., F.R.C.P., M.R.C.S.

[*November* 28, 1952]

A Two-Year-Old Goes to Hospital

A Film Shown By

JOHN BOWLBY, M.D., and JAMES ROBERTSON
Tavistock Clinic

Dr. John Bowlby: The theme of this film is a very commonplace one—simply the story of a child of 2½ years who spends eight days in hospital for a minor operation and who frets a good deal of this time. It may be asked why bother to make and show a film of something so commonplace?

The reason is that we believe that fretting should no longer be looked upon as an unavoidable inconvenience but as something of serious importance and worthy of scientific study. There is now evidence that prolonged periods of maternal deprivation in very young children can, in some cases, give rise to extremely serious psychiatric disturbances. There has been a succession of papers and monographs on this subject during the last fifteen years and two years ago WHO published a review of this evidence (Bowlby, 1951). Furthermore, it is becoming fairly well known that the majority of children under 4 years old who have spent only a brief period in hospital, or otherwise away from their mothers, show emotional upsets of shorter or longer duration.

Since the existence of the problem is no longer in doubt, the Research Team investigating it at the Tavistock Clinic is concentrating its attention on the *psychological processes* which lead to these adverse effects. We are giving special attention to the emotional responses of very young children during the first days and weeks following separation from their mothers. After a number of semi-systematic studies we decided eighteen months ago to attempt as full a coverage as possible of one child throughout her stay in hospital. It was during this pilot study that this film was made.

It is because we believe it permits of an objective examination of what actually happens when a young child has this experience that we think it may be of value in furthering our understanding of fretting and the emotional disturbances to which it can lead. We believe that it is only on the basis of this knowledge that improved methods of care can be developed.

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Mr. James Robertson: There are special difficulties in the way of getting objective data on the meaning of separation to children under 4. They can tell little in words, so that understanding has to be sought largely through interpreting their behaviour. As fieldworker I discovered that there were often limits to the agreement to be had in discussion with nurses and pædiatricians not only about the meaning of behaviour in certain young patients but also about the actual facts of that behaviour. There was a gap in observation and interpretation which could not be bridged. It seemed that emotional factors in the pædiatricians, nurses, and myself were suspect. I was thought at times to be diminished in my objectivity by becoming over-identified with the children; I in turn considered that a contrary phenomenon tended to occur in hospital staffs, namely that defences had built up in them against the painful recognition of the extent to which young patients are unhappy—not only in the initial phase of overt fretting but in later stages of being "settled in".

In the film I have tried to provide a record which will be accepted as objective, and which has the merit that the behaviour can be viewed as often as desired in discussion between interested groups. Thus I hope our mutual interest in discovering what is true will be advanced. Objectivity was sought

by several devices. A schedule of filming was agreed beforehand with the ward staff; it consists of documentary record of main events—such as admission, anæsthetic, parents' visits—and a daily "time sample" covering the same period and at intervals determined by a clock which is seen in the film. The child was selected at random by a hospital clerk from the list of those awaiting operation for umbilical hernia. Filming was done by myself with a hand camera in natural lighting. There was no other apparatus to disturb the ward and the child was not segregated. The only departure from routine was that a nurse was detailed to play with the child during the daily time sample.

Synopsis of Film

Laura is 2 years 5 months old, a first child and so far an only one. She is intelligent, mature, and has unusual control over the expression of feeling. She rarely cries. She is about to go into hospital for eight days to have a minor operation for umbilical hernia.

Although her parents had tried to prepare her for going into hospital, when she meets the admitting nurse she is cheerful and friendly and clearly does not realize that her mother will leave her. Going through the ward she seems less confident, and when she is undressed to be bathed she screams for her Mummy. Within ten minutes, however, her unusual control over feeling asserts itself and she is apparently calm.

She is put in a cot and breaks down again when nurse takes her temperature—"Don't like it. I want my Mummy". A few minutes later her mother comes to say good-bye, and leaves for her consolation a piece of blanket she has had since infancy and which she calls her "baby". Throughout her stay this "blanket baby" and her Teddy make a link with home and are clung to when she is sad or frightened.

When alone she appears calm, but if a kindly person stops to talk with her her feelings appear. Sister comes to greet the new patient and Laura's face crumples "I want my Mummy". This occurred throughout her stay: and the camera shows that what may easily be taken for calmness is often a façade which contact with a friendly person breaks down.

When the surgeon comes she clutches her Teddy and blanket "baby" for comfort, and despite his tact she is apprehensive and resistive. Occasionally during the day she asks quietly for her Mummy, but without insistence.

On the *second day* she looks strained and sad, and has difficulty in responding to the nurse who comes to play with her. Then her feelings appear and she cries a little for her Mummy. But though she cries little throughout her stay she takes great interest in the children who cry—as if they cry for her who is too controlled to cry. The rectal anæsthetic is kindly administered, but the strange experience frightens her. Thirty minutes after recovery from the anæsthetic her parents visit. She is very distressed—"I want to go home"—tries to get to her mother but has to be restrained because of the stitches, and rolls about on her pillow crying. As her parents leave she is subdued and seems perplexed. She waves slightly in response to their cheerful going.

On the *third day* she is seen quietly clutching her Teddy and blanket baby, not crying or demanding attention and likely to seem "settled" to busy ward staff. But when a nurse comes to play with her she is at first withdrawn, then in contact with the friendly person her feelings break through again and she cries bitterly for her Mummy. When the nurse leaves her control gradually reasserts itself. This cycle of withdrawal, breakdown, and resumed control is repeated shortly afterwards when the nurse again plays with her. In the afternoon her mother visits, but although Laura has been sitting up all morning and has wanted her mother she makes no attempt to get to her. Mother would like to take her in her arms but is deterred from doing so by what she believes to be hospital regulations. Ten minutes later a nurse sits her up, but it is fifteen minutes before Laura thaws out towards her mother. Then she becomes increasingly animated and friendly, and is transformed by a radiant smile seen for the first time in three days. When her mother says she has to leave Laura is immediately anxious, and as her mother leaves she turns her head away. She does not cry, but shows her feeling clearly by the change in her face and the restless movement of her hands. Although it is the middle of the afternoon she asks to be tucked down with all her personal possessions tucked around her and forbids the nurse to remove the chair on which her mother had been sitting.

On the *fourth day* the record is brief and featureless. She is not visited.

On the *fifth day* her mother visits in the afternoon, and again there is a period of withdrawal before she warms up to her mother. She asks to go on mother's lap, but when mother says she cannot she does not ask again. When her mother has to go Laura is pained, cries a little, then quietly recovers and sits with pursed lips.

On the *sixth day* a new child is admitted who cries a lot, Laura, very controlled herself, watches him with a tense face. (When she got up she went to him and said "You're crying because you want your Mummy. Don't cry. She'll come to-morrow.")

On the *seventh day* both parents visit and Laura is up for the occasion. Although she knows chairs are being set out for them she shows no excitement, and when her mother comes she makes no attempt to go to her. She remains subdued. When Daddy comes from the office ten minutes later he gets a warmer welcome. Daddy leaves first and his going is apparently almost ignored. She asked to go with him but does not insist. When her mother leaves, Laura apparently ignores her going.

On the *eighth* morning she is shaken by sobs. Her mother had told her the previous evening that she would be going home to-day and her control has given way. When her mother comes Laura remains cautious, however, and not until her outdoor shoes are produced does she accept that she is going home. She insists on taking all her possessions home with her, even a tattered old book she refused to leave behind. When she dropped that book on the way out and a nurse picked it up, she screamed in temper and snatched it away—the fiercest feeling shown during her whole stay. On the way out she is seen walking apart from her mother.

Dr. D. W. Winnicott (President of the Section) welcomed the film as a highly successful first effort. Here, as he saw it, was a normal child. She came into hospital and gradually became affected as a normal child must. She was fortunately spared that phase of false recovery to which the child reaches if the break from the home lasts too long, and which may make the child cling to the nurse in fear when at last the mother or father comes to take the child home.

The main comment Dr. Winnicott wished to make was that from long experience he could say that this film was definitely about a real problem. The effect of separation of small children from their mothers was so often serious, even producing irreversible changes, that every time when a child is to be taken into hospital there ought to be a careful weighing up of the value on the physical side against the danger on the psychiatric side. This principle is not vitiated by the undoubted fact that in certain circumstances certain children (not young ones) derive benefit and even enrichment from a stay in hospital—perhaps because of the relief that this affords on account of a parent's anxiety state or depression mood.

It is interesting that the child who *feels* ill seems to be less harassed by being taken into hospital than the child who feels well, but who is considered to need something done. A verbal explanation given to a young child, whatever is said, is of no value as compared with the child's own feeling that help is needed. On feeling better, however, the child begins to have an urgent need to go home.

[*January* 23, 1953]

Congenital Valves in the Posterior Urethra (Two Cases).—D. INNES WILLIAMS, M.D., M.Ch.

Case I.—The child was first seen at the age of 4½ months when he was admitted to the Hospital for Sick Children, Great Ormond Street, under the care of Mr. Twistington Higgins. He had previously been taken ill when 1 month old, with a high temperature, "pink" urine, and dribbling micturition; these symptoms had subsided rapidly with Chloromycetin, and he had not been referred for a urological opinion. The present attack commenced with abdominal pain and hæmaturia. The urine was infected with *B. coli*, and had a specific gravity of 1003. The blood urea was 51 mg./100 ml. The symptoms again subsided with Chloromycetin, but the bladder was found to be chronically distended.

A micturating cystogram (Fig. 1) was performed and showed a grossly dilated and elongated posterior urethra with reflux into an enormous right hydro-ureter. Intravenous pyelography showed no shadow on the right, and only poor secretion from the left kidney.

Operative treatment was by the method of "perineal valvulotomy". The bulb of the urethra was laid open and the membranous urethra dilated up. A miniature gorget was then passed in anteriorly, and a flat retractor posteriorly (Fig. 2). By the use of a head-light and a sucker it was then possible

FIG. 1.—Micturating cystogram (*Case I*).

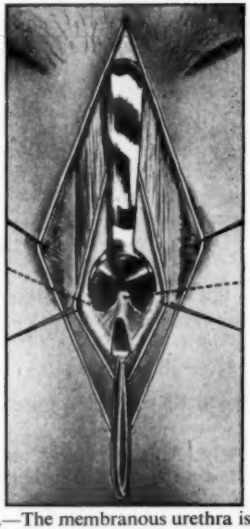

FIG. 2.—The membranous urethra is dilated up with sounds: a gorget is inserted anteriorly, and a narrow flat retractor posteriorly. The verumontanum and valves are thus exposed: the valves can be caught with a blunt hook and destroyed with the diathermy.

to visualize the verumontanum, and the valvular folds descending from it. The folds were picked up and destroyed with the diathermy. The bladder was then drained via the perineal urethrostomy.

A tender swelling appeared in the right loin and flank soon after the operation: it was clear that the right ureter had become kinked and acutely obstructed. Drainage of urine from the bladder

(derived from the left kidney) remained satisfactory. On the seventh post-operative day the right kidney was still acutely distended and the temperature was raised. A nephro-ureterectomy was therefore performed as it was felt that the destruction of that kidney was too far advanced to allow of recovery. The operation confirmed the view that the obstruction was due to kinking of the ureter a little below the brim of the pelvis, and, in retrospect, it seemed that this kidney might have been saved.

Subsequent convalescence was uneventful save for a slight hæmaturia on three occasions. One year after operation he remains well: his growth has been normal, the urine is sterile, and the act of micturition satisfactory. The blood urea remains high, however, at 70 mg./100 ml.

Case II.—This child was first investigated at the age of 7 years: he gave a history of continual incontinence of urine since birth. He passed urine in a poor stream, and always dribbled between the acts of micturition.

There was no evidence of neurological disease, the urine was sterile, and intravenous pyelograms showed no significant abnormality.

On cystoscopy he was found to have 6 oz. of residual urine, and a heavily trabeculated bladder. The bladder neck was somewhat relaxed, and descending from the verumontanum there were two well-marked valvular folds.

Micturating cystograms (Fig. 3) demonstrated the dilatation of the posterior urethra, and on careful inspection the actual outline of the valvular folds could be made out.

FIG. 3.—Micturating cystogram (*Case II*).

Destruction of the valves was undertaken endoscopically with a miniature McCarthy diathermy resectoscope. This operation reduced his residual urine to nil, and two months after the operation he is well, with sterile urine, and is dry by day and night.

Congenital Multicystic Kidney with Ectopic Ureter.—E. M. POULTON, D.M., M.R.C.P. (for E. HINDEN, M.D., M.R.C.P.).

Girl aged 11 years.

She complained of a continual dribbling incontinence of urine by day only. She also passed urine normally, though rather frequently, but the continual escape of urine was unaffected by this.

On inspection of the vulva urine could be seen issuing from the vaginal orifice in small gushes; after ingestion of methylene-blue, pledgets of cotton-wool placed in the vagina became blue. However, careful search in the vagina failed to reveal any ureteric orifice, nor was one found in the urethra.

Cystoscopy by Mr. Innes Williams showed that the right ureteric orifice alone was present. The left half of the trigone was deficient. An excretion pyelogram showed a normal right renal tract, but no excretion of the dye could be seen on the left side.

Retroperitoneal insufflation of oxygen was then carried out by Mr. Lang Stevenson; 500 mil. were introduced by the inferior pelvic approach. A subsequent X-ray showed the outline of a normal right kidney, while on the left side three spherical shadows were seen in the position of the left kidney (Fig. 1).

Operation.—Left-sided nephrectomy (Mr. Innes Williams). A kidney was removed consisting of 3 cysts, connected by a thin layer of renal tissue, overlying the renal pelvis (Fig. 2). The ureter was patent, but extremely narrow; it admitted a probe for 2 in. only.

FIG. 1.—Retroperitoneal insufflation of oxygen, outlining normal right and cystic left kidneys.

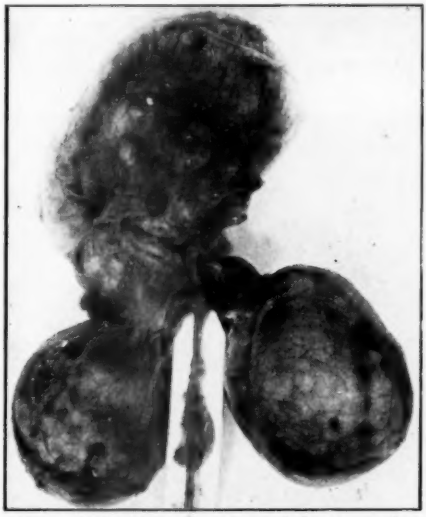

FIG. 2.—Left kidney after removal, for comparison with X-ray photograph.

Her condition was much improved by the operation; she is now dry so long as she leads a quiet life; if she exerts herself, however, she is conscious of a little urine escaping from her bladder; in consequence she is on some days slightly damp by the evening. It is suggested that her urethral sphincter, like her trigone, may be imperfectly formed.

Comment.—Some dozen cases of congenital unilateral multicystic kidney have been described in the past five years. In all these the condition presented as an abdominal tumour in the first two years of life. The association with atresia of the ureter is well recognized; Goodyear and Beard (1948), who described 2 cases, in one of which the ureter was represented by a filament, and in the other was only patent for the lower 2 in., suggest that ureteric obstruction may be the primary condition, the cysts representing hydronephrotic calyces.

No case has been found in the literature in which the ureter was shown to be ectopic, or which presented at such an advanced age.

REFERENCE

GOODYEAR, W. E., and BEARD, D. E. (1948) *Amer. J. Dis. Child.*, **76**, 203.

Hydronephrosis Treated by Pelvi-ureteroplasty.—R. C. FARROW, F.R.C.S. (for G. H. MACNAB, F.R.C.S.).

Ten-year-old male child. Admitted as an emergency to the Westminster Children's Hospital with a history of severe pain in the left loin for three hours associated with copious vomiting. The pain radiated to the mid-line of the abdomen but not to the groin. During the previous six months he had suffered identical attacks lasting up to twelve hours each and which had occurred about once a week. At no time had he suffered frequency of micturition or dysuria.

On examination.—T.98·4° F. Pulse 88. The abdomen was not distended and moved well on respiration. The child exhibited an ashen pallor and was obviously in great pain. There was acute tenderness in the left hypochondrium and loin and well-marked reflex rigidity.

Examination of the urine and investigation of the renal function showed them all to be within normal limits. I.V.P. showed a large left hydronephrosis with a "rounding off" of the lower border of the renal pelvis suggesting a block at the pelvi-ureteral junction (Fig. 1). The right kidney appeared normal. Cystoscopy showed a normal left ureteric orifice and a normal efflux was observed. The subsequent retrograde pyelogram revealed no further information.

At operation the kidney was approached through a left lumbar incision and a grossly enlarged renal pelvis was discovered. The pelvi-ureteral junction was bent back on itself in an S-shape and marked hypertrophy was present at this site. Peristaltic waves were seen to pass over the hydronephrotic sac and when they arrived at the pelvi-ureteral junction that portion of the ureter immediately distal to the junction appeared to be pulled upwards towards it. There was an obvious blanching of the pelvi-ureteral swelling, strikingly similar in appearance to that exhibited by the hardening of a pyloric tumour in pyloric stenosis of infancy. A diamond-shaped piece of tissue was excised from this swelling and the defect was closed in the transverse axis by fine interrupted catgut sutures (Fig. 2).

FIG. 1.—Intravenous pyelogram.

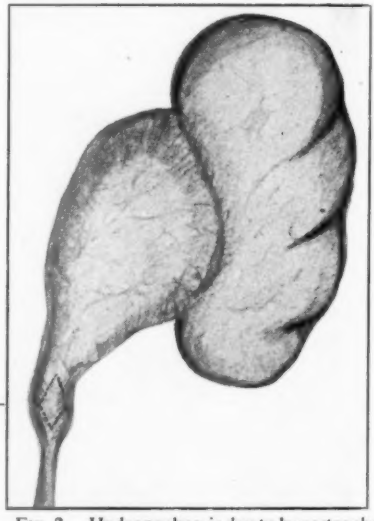

FIG. 2.—Hydronephrosis due to hypertrophy of pelvi-ureteric junction. Dotted line indicates tissue excised at operation.

Histologically the excised tissue showed a thickened ureteral wall with a considerable amount of œdematous fibrous tissue. There was hydropic degeneration of the muscle bundles but the mucosa appeared normal.

Subsequent I.V.P. one year later showed little alteration in the size of the hydronephrosis but during this whole period the child has remained well and symptom free.

I am indebted to Mr. G. L. Bunton, F.R.C.S., for his drawing of the operation findings.

Section of Surgery

President—Professor F. A. R. STAMMERS, C.B.E., T.D., Ch.M., F.R.C.S.

[*January* 7, 1953]

Infantile Hemiplegia

By WYLIE MCKISSOCK, O.B.E., M.S., F.R.C.S.

THE condition I propose to discuss is one of spastic hemiparesis coming on in the early months or years of life associated with epilepsy and with behaviour disorder. I am not concerned here with pure infantile hemiplegia unassociated with other physical or mental disturbance.

Some years ago Krynauw (1950*a*), the Johannesburg neurosurgeon, turned his attention to this condition and eventually reported (1950*b*) a series of 12 cases in which he had removed the entire cerebral hemisphere of the side opposite to the hemiplegia. He claimed that no decrease in power or alteration of cortical sensation followed such an operation but that the epilepsy and behaviour disorders were relieved. Further he brought evidence to show that mental improvement, as measured by learning capacity, was increased after the operation. In his opinion the mental changes, temper tantrums or behaviour disorders formed the most important criteria for operative intervention.

After a careful study of Krynauw's work we decided to carry out a series of such operations and it is of the first 18 such cases that I propose to speak.

It was a simple matter to review a long series of patients who had previously passed through our hands and select for admission and further investigation those who presented with hemiplegia, epilepsy and behaviour disorder.

METHOD OF INVESTIGATION

A panel or committee of interested persons was chosen so that each aspect of the case could be adequately examined both before and after treatment and, in addition, the panel met to discuss the advisability of operation before such a drastic step was taken.

The panel.—The chosen body consisted of the following: neurologist, psychiatrist, psychologist, radiologist, otologist, electrophysiologist and neurosurgeon. Each individual carried out such tests in his particular field as were required to assess the case fully. When the case was completely worked up the panel met and decided whether or not hemispherectomy was justifiable.

Symptomatology.—All patients were sufferers from epilepsy either in the form of major or minor seizures, if not of both. Most, in addition, had disturbance of behaviour: in the smaller children taking the form of frequent and severe temper tantrums. In the other cases the behaviour disorder might take the form of smashing up the house or institution or of attacking members of the family or inmates of the asylum. All were mentally retarded and had either fallen by the educational wayside or were being taught in special schools.

Pre-operative findings.—Clinically the patients showed a typical infantile hemiplegia, the affected limbs being smaller and shorter than those of the normal side. In older cases contractures had developed and spasticity was more marked than in the younger children in the series. In some cases disorganization of the upper limb had taken place from subluxation of joints. Power was diminished and range and type of movement limited.

Varying degrees of disturbance of cortical sensation were present but these were rarely very marked. Some patients had defects in the field of vision usually of a homonymous hemianopic kind. In the younger children such examinations were difficult to carry out and some uncertainty as to the presence of a hemianopia remained.

Mentally all cases showed some degree of retardation and the highest intelligence quotient in any case was about 70.

Electroencephalography.—Many recordings were made from all the patients but the findings were relatively inconclusive.

Radiologically a number of changes were observed. Straight X-rays of the skull usually revealed a hemiatrophy of the vault with thickening of the parietal bone on the side of the hemiatrophy.

Air studies.—These usually showed a gross dilatation of the entire lateral ventricle on the affected side, broadening of the third ventricle, a shift of the ventricular system towards the affected hemisphere,

enlargement of cortical air shadows and, in many cases, cyst formation around the line of the Sylvian vessels. Radiographs taken twenty-four hours after the initial air injection were often effective in exposing such cyst formation when it had not been visible in the routine films.

The dilatation of the lateral ventricle was variable in extent: some cases showed more evident enlargement in the parieto-occipital region, others in the temporal or frontal horn and the extent of the clinical neurological signs usually fitted in with the encephalographic findings. If, for example, the occipital horn was grossly dilated then a homonymous hemianopia was usually demonstrable. Careful study of the encephalograms sometimes suggested that the caudate nucleus and optic thalamus were unusually small on the affected side.

Arteriograms.—These have been performed in a number, although not all, of these cases and have not proved useful in demonstrating changes in the blood vessels of the affected hemisphere, although in cases with well-marked hemiatrophy there may be shift of the anterior cerebral vessels towards the side of the lesion.

Photography.—Much work has been done on making careful photographic recordings of the range and degree of movement possible on the hemiplegic side before operation in order to be able accurately to assess any changes due to operation. Cinematography has also been used extensively during operation to aid the verbal description of movements obtained by stimulation of excitable cortex or of the internal capsule after amputating the hemisphere.

Psychological testing.—This has been made as exhaustive as possible having regard to the capability and distractibility of the patients so that once again changes after operation may be definite one way or the other.

Conference

Once their data had been collated a meeting of the panel was called so that the case might be discussed in detail, the pros and cons put forward and a decision as to operative interference reached.

Operation

Anæsthesia.—The patients were induced with Pentothal, an endotracheal tube passed with the aid of a relaxant such as Flaxedil and the patients maintained on gas, oxygen and repeated small doses of pethidine. In the case of small children gas, oxygen and a trace of ether is probably better.

Intravenous cannulæ were inserted into each internal saphenous vein to facilitate the giving of intravenous drips and to ensure that blood transfusion could be given without delay if required. Transfusion has not often been required, especially as once the amputation of the hemisphere is about to be commenced, arterial hypotension is induced with C6.

Mid-parietal scalp and bone flaps were turned down separately, the median limb of the scalp flap being kept well to the affected side of the mid-line to avoid bleeding from the unusually large arachnoid villi sometimes encountered close to the superior longitudinal sinus.

The dura mater was next opened in the form of a flap with its base towards the mid-line. Shortly before this stage the depth of anæsthesia was lightened, so that cortical stimulation might be carried out, once the dura was open.

The exposed cortex has shown a variety of abnormalities but by far the most common is an area of cystic degeneration around the Sylvian fissure, involving the temporal lobe extensively and the parietal lobe above in lesser degree. The convolutions around the cystic area are often narrowed, hard and irregular in outline.

A map of the excitable cortex was next made and was found to vary enormously from case to case. The area of stimulation was marked and the response obtained recorded both verbally and by cinematography.

In some cases also electrocortiograms were taken but this was not a routine procedure.

Amputation of the hemisphere—usually after the induction of controlled hypotension—was then performed, the frontal lobe being removed first, followed by the parieto-occipito-temporal lobes in a single mass. The choroid plexus was then excised as leaving it might result in a subsequent hydrocephalus developing. The structures remaining after the amputation were the caudate nucleus, optic thalamus and hippocampus.

At this point, apart from closing dural, bone and scalp flaps the operation was at an end but we have felt it desirable to obtain the maximum of information of physiological interest if the condition of the patient permitted. In certain selected cases, therefore, the surface of the divided internal capsule has been stimulated electrically or a window has been cut in the falx cerebri to expose the medial aspect of the remaining hemisphere for stimulation of excitable cortex here. The results of such stimulation have again been recorded both verbally and by cinematography. Bilateral limb movements have been obtained from stimulating the medial aspect of the sound remaining hemisphere.

Closure of the wound was then required and was done in the usual meticulous neurosurgical manner with a vast number of black silk sutures.

Within a few minutes of the end of the procedure the patients responded verbally or moved in response to painful stimuli or to verbal orders, irrespective of which hemisphere had been removed or the handedness of the individual.

Post-operation Course

There was little of note in the first few post-operative days other than the not inconsiderable rise in temperature which increases nightly for a few days and then gradually diminishes for several more.

Convalescence was otherwise similar to that after any major intracranial operation. Sutures were, of course, removed on the second day when the wound was healed. Patients were got out of bed at the end of a week unless the pyrexia still persisted.

Complications.—These have been few but for the earlier cases where it had not been thought necessary to excise the choroid plexus; these were 2 patients who developed a secondary hydrocephalus necessitating subsequent surgical procedures.

Mortality.—We have been fortunate in this matter in that there has been no death in the immediate post-operative phase but one patient did succumb three months after operation from an unsuspected low-grade infection producing a unilateral pyocephalus. This patient had suffered both a mild thrombophlebitis of the leg and a urinary infection in the first post-operative weeks and whether the pyocephalus was due to a blood organism or to infection at the time of operation cannot be established.

Results

The effect of operation has been to eliminate or greatly diminish epilepsy, to remove entirely behaviour disorder, to produce a homonymous hemianopia with splitting of the macula—if such was not present before operation—and to affect power and sensation in minimal degree.

Deficits.—It may be considered certain that a homonymous hemianopia will be acquired, if not already present. There will be minimal aggravation of cortical sensory loss as compared with the pre-operative state but this will not be of a degree significant to the patient or even appreciable by him.

There may be slight loss in the ability to use the arm or leg but this is usually more than offset by the decrease in pre-operative spasticity, which is also a usual sequel to hemispherectomy.

Gains.—Reduction or elimination of epilepsy. Abolition of temper tantrums (Table I). Lessened distractibility. Capacity to learn is increased or restored if previously lost. In certain of the older patients a definite increase in I.Q.

Decreased spasticity of the affected limbs leading to greater freedom and facility of movement (Table II).

Table I

	Epilepsy	Temper tantrums	
Unchanged	1	2	Unchanged
Occasional fits { Major	3	1	Too young
Occasional fits { Minor	1		
No fits	12	14	None
Died	1	1	Died
Total	18	18	

Table II

	Hemiplegia	Mental state
Unchanged ..	12	3
Worse	2	1
Improved ..	3	13
Died	1	1
	18	18

Table III

	Patient			Fits	Tantrums	Motor	F–U	General
I	M.	4	R.	None	None	Same	3	Developing slowly
II	M.	11	L.	Occ. major	None	Worse	2¾	Developing slowly
III	M.	4	R.	None	None	Better	2½	Developing slowly
IV	F.	20	R.	None	None	Better	2½	Considerable improvement
V	M.	23	R.	Major and minor	As before	Same	2½	Unchanged
VI	M.	4	L.	None	None	Same	2	Developing slowly
VII	M.	21	L.	Occ. minor	None	Better	2	Developing slowly
VIII	M.	1½	R.	None	None	Same	1¾	Too young to say
IX	M.	13	R.	None	None	Same	1¾	More contented
X	M.	12	L.	Occ. major	As before	Worse	1¾	Worse
XI	M.	17	R.	None	None	Same	1¾	Much improved
XII	F.	4	L.	None	None	Same	1¾	Developing slowly
XIII	F.	17	L.	—	—	—	—	Died three months later
XIV	M.	26	R.	Occ. major	None	Same	1¼	Much improved
XV	M.	23	L.	None	None	Same	1¼	Much improved
XVI	M.	8	L.	None	None	Same	1	No change
XVII	F.	9	R.	None	None	Same	1	Developing slowly
XVIII	F.	18	R.	None	None	Same	1	Improved

2 of our 18 patients (Table III) have unquestionably suffered as a result of the operation: both of these were errors of judgment on my part. One developed an increase in the hemiplegia which has fortunately been offset by disappearance of a severe behaviour disorder, whilst the other has acquired

an increased speech defect. This latter case should have been subjected only to a local excision of abnormal parietal cortex rather than to total ablation of the hemisphere. These were early mistakes which should not occur again.

Illustrative case.—The following is an example of what may be expected of total hemispherectomy in a reasonably intelligent, though sub-normal, infantile hemiplegic.

The patient, a girl aged 20, was fortunate in having an admirable mother who cared so well for her daughter that she was able to do a job of work as a packer in a factory in spite of frequent generalized epilepsy. The patient, if left to herself was dirty, untidy, unable to care for herself properly and would masturbate openly before the family. She was difficult, argumentative and irritable at home. Bereft of her mother's aid she would soon have been admitted to an institution where she would have remained for life.

Hemispherectomy produced no change in the spastic paralysis of the hand, but improved the leg to an extent that was proved by the lack of need for constant repairs to the sole of the shoe on the affected side.

Epilepsy was abolished; her bad temper disappeared; she became clean in her habits and no longer masturbated publicly. She continued to be employable and wage earning. Later she married and is now able to care adequately for herself, her husband and her flatlet. She is virtually unaware of her hemianopia, a left homonymous defect.

In the younger children much more time must elapse before a true assessment of educational progress can be made, but the opinion of the parents leaves no doubt in our minds that they present far simpler problems in the home than they did before operation. One unfortunate woman indeed has produced a second hemiplegic infant whom she brought to hospital aged 6 months asking for hemispherectomy as it had proved so satisfactory in her elder boy.

The work described here should be regarded as a collective effort on the part of the panel, of which I have been the surgeon. The members of the panel are: Doctors J. A. V. Bates, J. W. D. Bull, E. A. Carmichael, W. A. Cobb, C. V. Jackson, J. McFie, W. Mair and E. S. Slater.

The cinematographic films shown to illustrate movements obtained by cortical and capsular stimulation were taken by Dr. J. A. V. Bates and they represent part of his original research work on this subject.

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KRYNAUW, R. A. (1950*a*) *S. Afr. med. J.*, **24**, 539.
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The Management of Tuberculous Bacilluria

By J. COSBIE ROSS, F.R.C.S., Ch.M.

TUBERCULOUS bacilluria may be defined as the finding of the organisms in the urine in the absence of either radiographic or cystoscopic evidence of tuberculosis. This may be somewhat arbitrary, but it is necessary to start from some fixed point. I have deliberately excluded post-operative bacilluria as this presents quite a different problem.

Patients with tuberculous bacilluria fall into three categories:

(1) Accidental findings during routine microscopic examination of the urine.

(2) Successful search for organisms in the urine of patients being treated in a sanatorium for phthisis or bone-joint tuberculosis.

(3) Successful search in the urine of young individuals with minor urinary symptoms.

The third is undoubtedly the most important group.

It is, of course, impossible to consider tuberculous bacilluria except in relation to the main problem of renal tuberculosis. Similarly, renal tuberculosis cannot be considered by itself, but only in relation to tuberculosis regarded as a constitutional disease.

The following observations are the result of investigations carried out by a small group of us at Wrightington Sanatorium, where I have charge of a genito-urinary unit of thirty beds. The classification we use (with minor modifications) is that suggested by Jacobs:

(1) Early minimal lesion of renal parenchyma.
(2) Unilateral renal lesion with cystitis and nephrectomy or partial nephrectomy.
(3) Bilateral renal lesion with cystitis and nephrectomy, or partial nephrectomy, of the worse kidney.
(4) Cystitis and involvement of the remaining kidney after nephrectomy.
(5) Major bilateral disease.

For many years it has been recognized that tubercle bacilli may be found in the urines of patients showing neither the symptoms nor other indications of renal tuberculosis. In these patients, however, there is always an active focus of tuberculosis outside the urinary tract. This observation led Wildboltz and others to postulate the passage of tubercle bacilli through a normal kidney. This view is incorrect and the work of Medlar (1932), Band (1948) and others has shown beyond question that the presence of tubercle bacilli in the urine indicates a focal lesion in one or both kidneys, with the proviso that occasionally the tuberculous focus may be in the prostate or seminal vesicles.

In Medlar's classical work, carried out in 1926, 100,000 serial sections were cut from the kidneys

of 30 patients dying from pulmonary tuberculosis. The majority (75%) of these kidneys revealed microscopic lesions, 75% of which were situated in the cortex. Similarly, Medlar found microscopic scars, again usually found in the cortex, and concluded that these were healed tuberculous lesions. It is not unlikely that many of us have healed renal scars in exactly the same way as many normal individuals exhibit healed phthisis.

Again, Band has demonstrated that bacilluria occurred in over 20% of 300 patients suffering from extrarenal tuberculosis, and, of 27 fatal cases, bilateral microscopic renal tuberculous lesions were found in the cortex in 22. Thomas and Kinsella (1934) showed that in 650 sanatorium patients, whose urines were periodically investigated over a period of years, almost 40% had a positive urine, though not necessarily constantly so. Harris's work (1930) with bone and joint tuberculosis of childhood also demonstrated the transient nature of the bacilluria.

Pathology

On inspection of the cut surface of the kidney no abnormality can be seen, but microscopic examination of the cortex may reveal minute lesions ranging from the mononuclear or epithelioid tubercle to the follicle showing caseation and giant-cell formation. These early lesions are found generally in the glomeruli or sometimes in the capillaries between the convoluted tubules.

There are, I believe, two pathological types responsible for pre-clinical or sub-clinical renal tuberculosis. The first might be described as the Medlar microscopic focus, while in the second the Medlar focus has developed into a small cortical abscess.

The first type either heals without treatment or else the urine becomes sterile as soon as treatment is instituted. In the second, more advanced stage, the urine may remain positive in spite of antibiotics.

To summarize the position:

(i) The infection is blood-borne.
(ii) Cortical lesions are the most frequent.
(iii) Cortical lesions frequently heal.
(iv) The infection is often bilateral.
(v) Tubercle bacilli in the urine indicate tuberculosis of the kidney.

Incidence

As already mentioned, a tuberculous bacilluria occurred in over 20% of Band's series of 300 extrarenal lesions. Table I shows the number of patients with a subclinical lesion in relation to the five groups of renal tuberculosis in my own series of patients.

Table I

Group	1	44
	2	44
	3	13
	4	32
	5	23
	Total	156

It is difficult, if not impossible, to estimate the numbers of patients who have undetected bacilluria, and whose tiny cortical lesions heal without clinician or patient being any the wiser.

Harris's demonstration of transient bacilluria in tuberculous bone and joint lesions in childhood amply confirms the fact that the Medlar focus must frequently heal. (Renal tuberculosis is, of course, rare in childhood.)

Search for Tubercle Bacilli in the Urine

My colleague, Dr. C. A. St. Hill, has carried out exhaustive experiments to ascertain the most reliable method of proving the presence of tubercle bacilli in the urine. The urine of each patient in the genito-urinary unit at Wrightington Sanatorium is examined at six-weekly intervals. Catheter specimens were discarded as it was found to be extremely difficult to eliminate secondary contaminants. (Catheter specimens were assayed to cope with the possibility that the sodium hydroxide, needed to destroy contaminating organisms, might reduce the number of positive results by its toxic or lethal action on the tubercle bacilli themselves.)

The technique is as follows:

The total twenty-four-hour specimen is allowed to stand for forty-eight hours, after which the whole of the thick deposit is withdrawn. An equal volume of urine lying immediately above the deposit is also withdrawn into a separate container. These two specimens are centrifuged, the deposits treated with sodium hydroxide and neutralized. The resultant mixtures are divided into two parts. One half of each is inoculated on to two Lowenstein-Jensen slopes and the other half of one of them inoculated into two guinea-pigs. The early morning specimen is treated in a similar manner (Fig. 1).

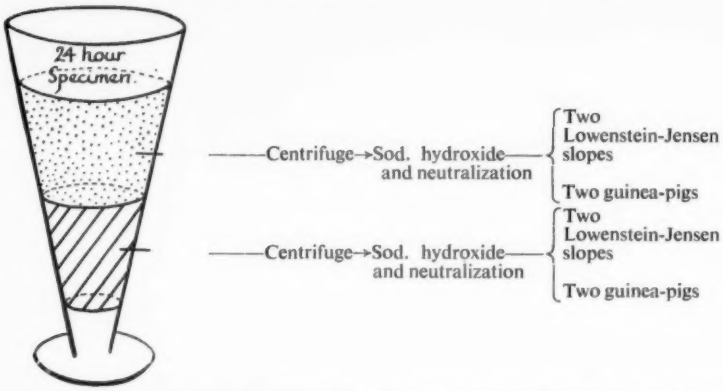


FIG. 1.

By this means, in each six-weekly investigation, the deposits from thirty-six hours are inoculated on to six Lowenstein-Jensen slopes and into 4 guinea-pigs. The results obtained are shown on Table I.

TABLE I

		No.	Positive
Early morning	culture	93	7
	guinea-pig	93	19
24-hour specimen—"sludge"	culture	90	4
	guinea-pig	57	7
"supernatant"	culture	90	7
	guinea-pig	42	3

The results may be summarized thus:

(i) The early morning specimens are giving results as good as those obtained from twenty-four-hour samples.

(ii) The guinea-pig inoculations are giving better results than cultural methods.

It is obvious that it is in those laboratories where an especial interest is taken in tuberculosis that the greatest number of positive findings are to be expected. Dr. St. Hill's impression is that the larger the volume of urine centrifuged, the more accurate are the findings. He is now using a large centrifuge which spins about 800–1,000 c.c. of urine.

SYMPTOMS

Although the condition may be truly pre- or sub-clinical, symptoms, however trivial and transient, are often present. A medical student with the solitary symptom of dysuria and a colleague with an attack of acute pyelitis lasting a few days, were both found to have tubercle bacilli in the urine.

A premonitory albuminuria sometimes occurs and a persistent *B. coli* bacilluria is a frequent finding. Lethargy and increasing loss of stamina may not be specifically complained of by the patient, but he will notice their disappearance and will experience a sense of well-being when treatment is commenced.

The lesson to be learned from all this is that every young adult with persistent mild urinary symptoms must be suspected of tuberculosis and thoroughly investigated.

In our series the following symptoms were noted:

SYMPTOMS

Frequency	diurnal	15	Epididymitis 13
	nocturnal	12	Symptoms of acute pyelitis 2
Dysuria		6	Accidental finding 5
Hæmaturia		3	Previous tuberculous lesion (extrarenal) 23
Pain in the loin		5	

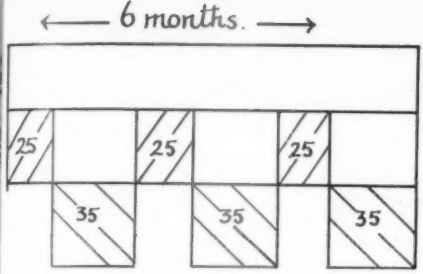
TREATMENT

Every patient with a tuberculous bacilluria should have the full course of treatment as for renal tuberculosis. It is impossible to predict the case which will heal spontaneously, and, in any event, the treatment may "scotch" the primary focus as well. Perhaps in years to come these patients will *not* come back with tuberculosis elsewhere as they did so frequently in the pre-antibiotic era. An efficient course of treatment is the best insurance against future tuberculosis either renal or elsewhere.

The course we have been using at Wrightington is shown in Fig. 2.

By giving streptomycin intermittently not only are toxic manifestations less frequent, but fewer resistant strains appear. BPAS presents a considerable advance on PAS itself. My co-worker, Mr. J. G. Gow, has shown that this calcium salt of N. Benzoyl PAS is tasteless, is non-toxic and is just as effective as PAS. So many patients are troubled with nausea, vomiting and anorexia when taking PAS that we have found the calcium salt a boon.

We have not yet reached a final conclusion regarding the dosage of isoniazid. It should certainly be given at the same time as streptomycin, but whether it should be given intermittently (in view of



←FIG. 2.

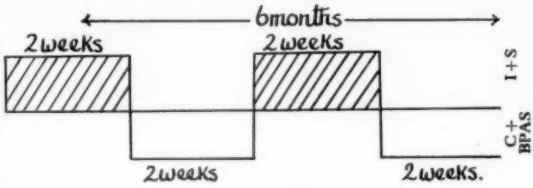


FIG. 3.

KEY for Figs. 2 and 3.
I = Isoniazid. C = Carbazone.
S = Streptomycin.

the rapidly developing resistant strains) has not been decided. Fig. 3 shows the method we intend to employ for the next twelve months period:

PROGNOSIS

In *children* with tuberculous bacilluria and in *some* adults the condition apparently healed spontaneously in the pre-antibiotic era. In a significant number of adult patients, however, tuberculous bacilluria progressed to an overt renal lesion.

At least ten years must pass before a real assessment of the results is possible, but there does appear to be some evidence that these patients progress more satisfactorily now than in the past. This is supported by the fact that repeated examinations of the urine reveal no organisms after the commencement of treatment in 26 out of 44 patients. As already mentioned, it is also to be hoped that subsequent tuberculous lesions elsewhere may be prevented.

TABLE II.—EXAMINATION OF THE URINE

(January 1951–August 1951)

No. of patients	2 months	4 months	6 months	After discharge 3 months	After discharge 6 months
6	−	−	−	−	−
2	−	+	−	−	−
3	+	+	+	+	+
1	+	−	−	−	−
1	−	−	−	+	−
2	−	−	+	−	−
1	−	+	+	−	−
Total 16					

(September 1951–December 1951)

No. of patients	2 months	4 months	6 months	After discharge 3 months	After discharge 6 months
6	−	−	−	−	−
2	+	−	−	−	−
2	−	+	−	−	−
1	+	+	−	−	−
1	+	−	−	+	−
Total 12					

(January 1952–June 1952)

No. of patients	2 months	4 months	6 months
4	−	−	−
2	−	−	+
Total 6			

SUMMARY

Total number of patients	34	
Remaining guinea-pig negative ..	16	19 satisfactory cases
Guinea-pig negative after two months	3	
Remaining guinea-pig positive after two months and therefore unsatisfactory	15	

CONCLUSION

In conclusion, we should look for the condition especially in young adults with albuminuria, with persistent *B. coli* bacilluria and with recurrent mild urinary symptoms.

When tuberculous bacilluria has been diagnosed we should institute a full six-months' régime, preferably in a sanatorium. It is in this type of lesion that antibiotic therapy holds out the greatest hope, and perhaps may afford an example of preventive medicine at its best.

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Steatorrhœa in Œsophago-gastric Surgical Practice

By R. H. F. Brain, M.B., F.R.C.S.

My interest in this subject has centred around the chronic malnutrition that almost inevitably follows certain œsophago-gastric operations, especially the very radical resections of the stomach. It is characterized by a severe loss of weight in the post-operative period which only a very small percentage of the patients are able to regain.

The cause of the malnutrition would appear to be due to:

(1) The severe limitation of calorie intake consequent on the low capacity for food, this being due to the early onset of symptoms of the dumping syndrome and often dysphagia, because of an œsophagitis usually from biliary and alkaline intestinal juice regurgitation.

(2) Steatorrhœa: Of the two the limitation of calorie intake would appear to be the more important, as the steatorrhœa, apart from during the first three post-operative months, is mild and can usually be completely corrected by frequent high fat content meals.

It is considered that both these faults originate from a common cause, namely that of "food dumping". Therefore, a study of fat digestion and absorption in these and allied cases has been made in the hope that since the mechanisms controlling fat absorption appear to be more delicate than those controlling other foodstuffs, this fact could perhaps be used as an "indicator" in the investigation of the more fundamental causes of malnutrition.

Stammers, F. A. R., and Brain, R. H. F. (1951, *Lancet*, i, 1137) dealt with steatorrhœa occurring following routine radical sub- and total-gastric resections. This paper is a continuation of this work and demonstrates the effects on fat absorption of other œsophago-gastric operations, with special reference to the ætiology of the steatorrhœa.

By steatorrhœa the modern understanding of the term is meant, namely, "the presence of excess fat in the stool whether obvious or not compared with the known fat intake". Occasionally visible fat in the stool which is liquid, bulky, frothy and offensive will be seen, but it is unusual.

Possible causes of steatorrhœa are illustrated (Table I) but for the present interest is centred on Group C which shows the curious anomaly of a fat absorption defect in the presence of apparently normal upper intestinal digestive factors, and lower intestinal absorptive capacity.

Table I.—Malabsorption of Fat

	A	B	C
Intra-lumenar factors Pancreatic juice + bile	Absent or defective	Present ? normal	Present ? normal
Intestinal absorption capacity	Normal	Defective	? normal
	Pancreatic and/or biliary syndrome	Sprue syndrome	Gastrectomy syndrome

Theorizing on the ætiology of the steatorrhœa, one has first of all to consider what is believed to be the normal role of the stomach and first part of the duodenum in fat digestion and absorption, it will then be seen how important is:

(*a*) The storage capacity of the stomach. (*b*) The slow emptying rate of the stomach.

(*c*) The careful co-ordination of the slow gastric emptying with biliary and pancreatic juice secretions.

These points emphasize the very real importance of the first part of the duodenum aided by its hormonal secretions, which affect the "emptying" of the stomach, by reduction of tonus, inhibition of peristalsis and control of the pyloric sphincter (Fig. 1).

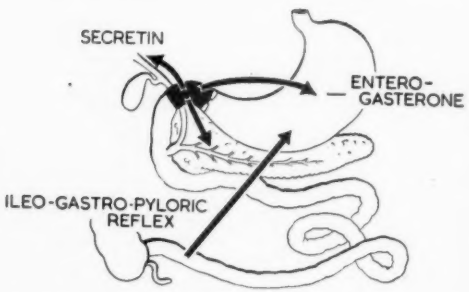

Fig. 1.—Dynamic role of the stomach and duodenum in fat digestion and absorption.

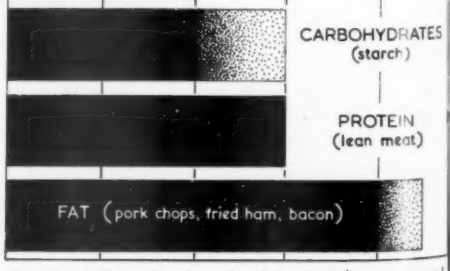

Fig. 2.—Effect of various foods on gastric storage and emptying times.

FIG. 3.

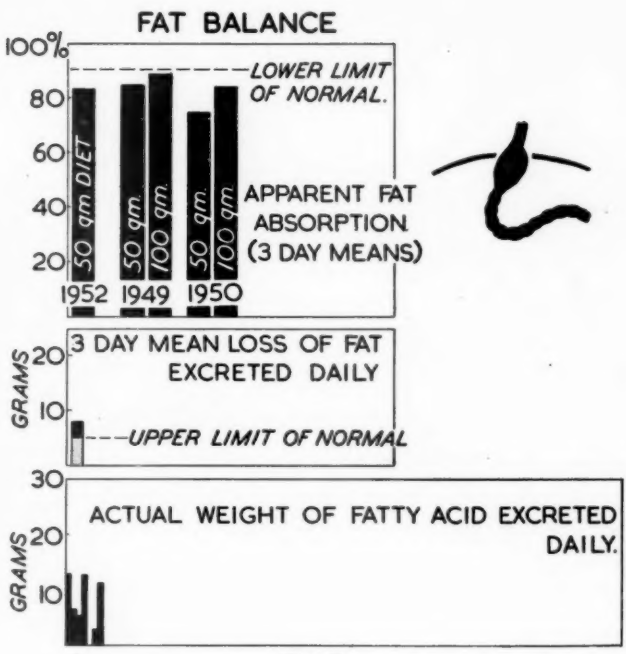

FIG. 5.

Hawk *et al.* (Hawk, P. B., Rehfuss, M. E., and Bergeim, O., 1926, *Amer. J. med. Sci.*, **171**, 359) studied the effect of various foods on gastric emptying times and demonstrated that fat and fatty foods are normally emptied slowly from the stomach compared with other foodstuffs (Fig. 2).

Ætiology of Steatorrhœa of the "Gastrectomy-syndrome" Type

With these facts in mind two possible causes have been considered:

A. Interference with the normal upper intestinal tract storage and co-ordinating mechanism.

B. An unknown "intrinsic gastric factor".

A study of some aspects of these theories has been possible by using three further groups of post œsophago-gastric operative states.

Subtotal Gastrectomy Leaving Pyloric Canal, Pylorus and Continuity with the Duodenum

In this group 2 cases illustrate the effects on fat absorption of subtotal gastrectomy from above down, leaving what was felt to be the very important pyloric canal, pylorus and continuity with the first part of the duodenum.

The first operation was performed for a case of total thoracic stomach with a very large lesser curve ulcer. The post-operative barium swallow demonstrates the new anatomy (Fig. 4). A fat balance study, based on the routine daily estimation of fat excreted shows the percentage absorption estimated on a three-day mean basis, together with the percentage fat absorption found in studies made in 1949 and 1950 (Fig. 5). The mildness of the defect and its apparently stable state will be seen.

The second patient in this group was operated on for carcinoma of the cardia. A post-operative barium swallow study was made (Fig. 6). Fat balance tests revealed a very mild fat absorption defect, the percentage absorption on the 100 grammes/day fat diet demonstrates again the importance of a high fat content diet for this type of case, as it gave consistently normal figures after the first day (Fig. 7).

Clinical consideration, however, of this group shows that, despite the leaving of the lower stomach, the pylorus, continuity with the first part of the duodenum and a good fat absorption, malnutrition still followed, as exampled by a photograph of the first patient in this group (Fig. 3). This is due to their deficient total calorie intake mainly because of severe dysphagia from œsophagitis, and believed to result from the use of the œsophagus as a food storage organ and the regurgitation of intestinal juices. A further post-operative barium swallow study well illustrates the effect of the functioning pylorus in these cases giving rise to fluctuating fluid levels in the œsophagus synchronous with peristalsis in the remainder of the stomach (Fig. 8). Food was found in the gastric remnant often from one and a half to two hours after the meal.

FIG. 4.

FIG. 8.

FIG. 6.

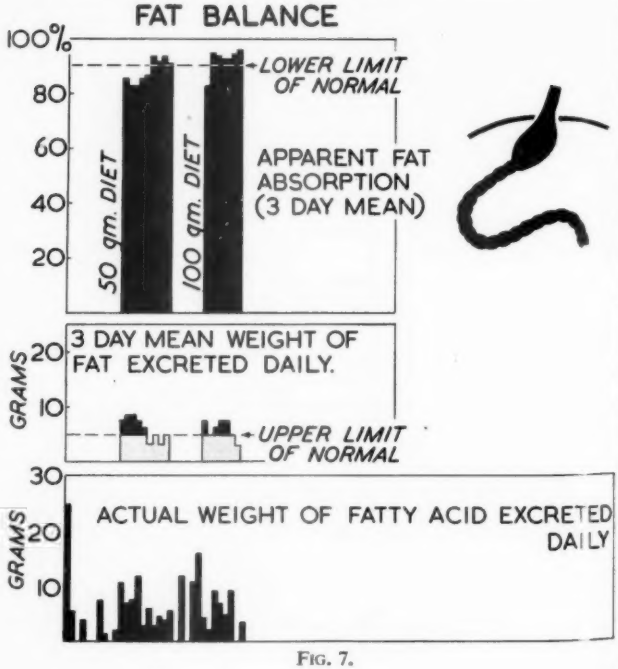

FIG. 7.

Œsophago-jejunostomy with Intact Normal Stomach In Situ

Again 2 cases have been selected for demonstration (Figs. 9 and 10, 11 and 12). These are taken from among several others all operated on for severe œsophagitis often with stricture formation of

FIG. 9.

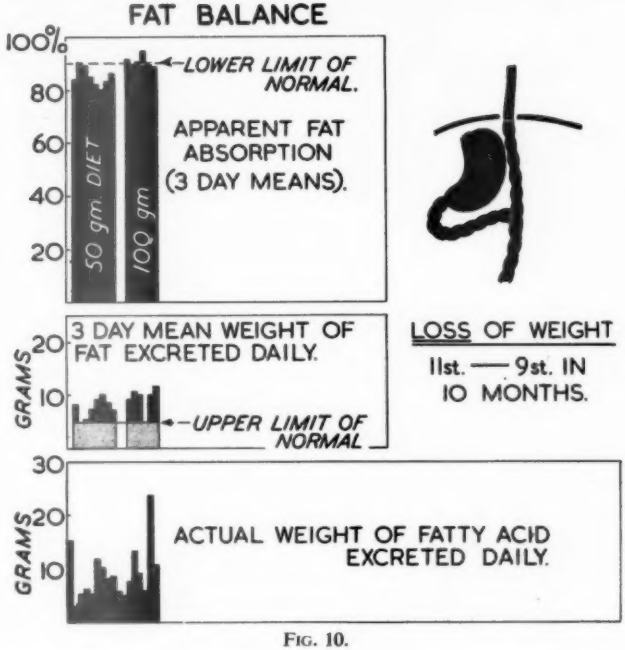

FIG. 10.

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FIG. 11.

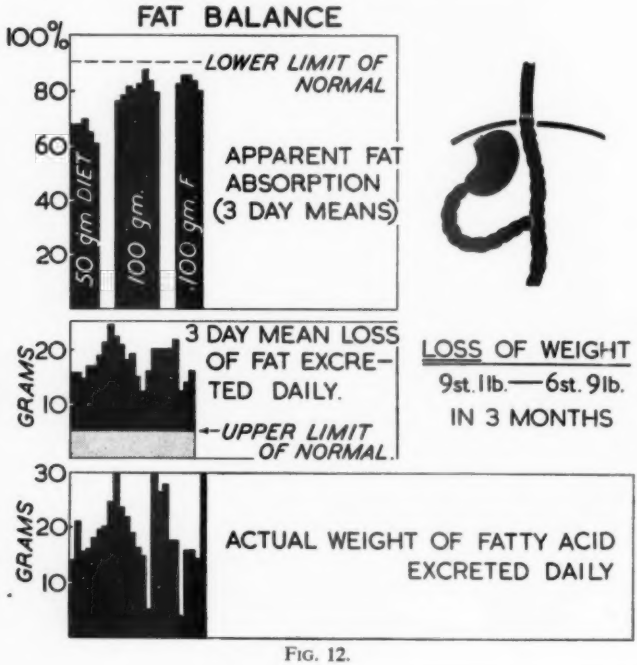
FAT BALANCE
100%
80
60
40
20
LOWER LIMIT OF NORMAL
50 gm DIET
100 gm.
100 gm. F
APPARENT FAT ABSORPTION (3 DAY MEANS)
GRAMS
20
10
3 DAY MEAN LOSS OF FAT EXCRETED DAILY.
UPPER LIMIT OF NORMAL.
LOSS OF WEIGHT
9st. 1lb.—6st. 9lb.
IN 3 MONTHS
30
20
10
GRAMS
ACTUAL WEIGHT OF FATTY ACID EXCRETED DAILY

FIG. 12.

the lower œsophagus, resulting from the effects of incompetence of the cardia in gastric œsophageal hiatus herniæ. They are thought to be important when considering the theory of an "unknown intrinsic gastric factor" as a cause of the steatorrhœa.

Following excision of the inflamed and strictured lower œsophagus the cardia was closed and the stomach returned to the abdomen. Continuity of the alimentary tract was established by a Roux γ œsophago-jejunostomy. The post-operative barium swallow study demonstrates this (Fig. 9). Fat balance tests show good absorption, even further improved in the usual way by increasing the total fat intake from 50 to 100 grammes (Fig. 10). The second patient in this group is illustrated in a similar way, i.e. with a post-operative barium swallow study and a fat balance chart (Figs. 11 and 12).

Despite a good absorption of fat, gross weight loss occurred in these cases, due to deficient total calorie intake consequent on symptoms of "dumping". This operation would, therefore, appear to confer on most patients the effects of a physiological total gastrectomy. Further it goes some way towards suggesting that the "unknown intrinsic gastric factor" mechanism may be a myth since steatorrhœa and wasting still occur. However, this cannot be taken as final since the stomach, although present and normal, is non-functioning, and we may, therefore, still have an extrinsic/intrinsic factor mechanism similar to that of the hæmopoietic factor of Castle, responsible for the mal-absorption.

Replacement of the Lower Œsophagus by an Isolated Jejunal Segment

As a result of the experience of the preceding patients, fourteen months ago a similar benign stricture of the lower œsophagus was treated by excision of the stricture area and replacement of it by an isolated

FIG. 13.

FIG. 14.

jejunal segment (*see* Fig. 13). The stomach previously partly in the chest was restored to the abdomen, the cardia closed, and the lower end of the jejunal segment, the upper end of which had been anastomosed to the œsophagus, put obliquely into the fundus where it joined the greater curvature (*see* Fig. 14).

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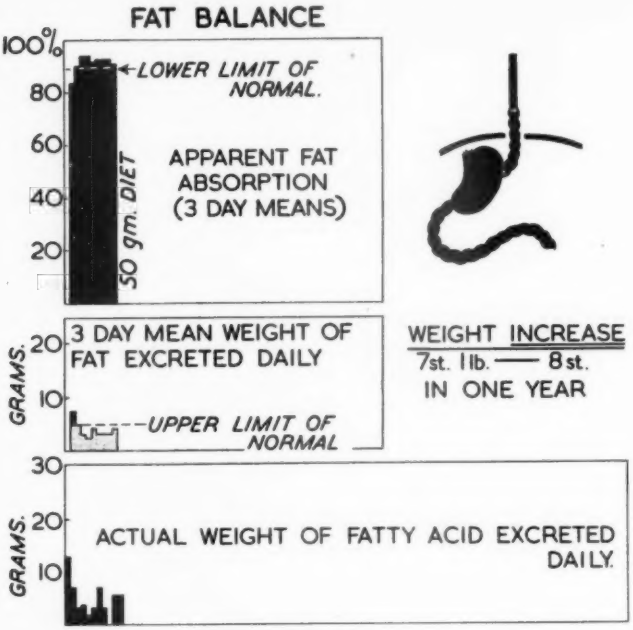

FIG. 15.

The fat balance studies are normal (*see* Fig. 15). The patient has put on almost a stone in weight in the first year after operation due to the absence of steatorrhœa and what is even more important a normal capacity for food. A normal number of good-sized meals can be eaten without trouble each day.

SUMMARY AND CONCLUSIONS

(1) Where the œsophagus is anastomosed to the pyloric canal after subtotal gastrectomy from above down, and where an intact normal stomach is by-passed by an œsophago-jejunostomy, steatorrhœa is a post-operative complication.

(2) The fat absorption defect is but a moderate one and can invariably be compensated for by a high fat content diet preferably divided up into numerous meals throughout the day. It is, therefore, felt that steatorrhœa alone plays but a very small part in causing the state of chronic malnutrition seen in such cases.

(3) Attention is drawn to the importance of gastro-duodenal dynamics and their co-ordination with the biliary and pancreatic tracts especially in fat digestion and absorption; it is suggested that their upset is the most likely cause of the steatorrhœa met with in these cases.

(4) Retention of the pyloric canal, the pylorus and continuity with the duodenum while perhaps favourably influencing the fat absorption defect, carried with it a definite morbidity, since the use of the œsophagus as a food storage organ favoured alkaline intestinal juice regurgitation with the development of œsophagitis and dysphagia. Weight loss and inability to easily regain it therefore indicated the failure of this type of operation.

(5) Œsophago-jejunostomy for benign lower œsophageal lesions leaving an intact normal stomach in situ, would appear to confer on the patients the burden of a physiological total gastrectomy.

(6) In the one case where an isolated segment of jejunum was used to replace the lower œsophagus, the result has been satisfactory in every way. This is shown by normal fat absorption, an excellent capacity for calories and a gain in weight of almost a stone in the first year of operation.

Section of Epidemiology and Preventive Medicine

President—Professor ROBERT CRUICKSHANK, M.D., F.R.C.P., D.P.H.

[*February* 20, 1953]

DISCUSSION ON THE EPIDEMIOLOGY AND TREATMENT OF SALMONELLA INFECTIONS IN MAN AND ANIMALS WITH SPECIAL REFERENCE TO *SALM. DUBLIN*

Dr. Joan Taylor [*Abstract*]:

Salmonella infections in man are still very common, the number reported having increased in recent years. This increase is partly the result of improved methods of collecting reports and partly a true increase. Excluding the enteric organisms, *Salm. typhimurium* is the most common, being responsible for almost 75% of the 5,094 cases which occurred during 1949–51.

In the same period 92% of cases were due to endogenous types, those recognized in this country before 1939. The endogenous type *Salm. dublin* was responsible for comparatively few cases, about 2%. Irrespective of the type of infecting organism, the total number of patients in epidemics always exceeds the number of sporadic cases. An analysis of patients' clinical histories in relation to the type of infecting organism was made to determine whether there was any indication that some types caused a more serious disease (Table I).

TABLE I.—SEVERITY OF INFECTION (LENGTH OF ILLNESS)—1949, 1950, 1951

Cultures, Total No.	*S. enteritidis* 310		*S. thompson* 272		*S. dublin* 102		*S. newport* 197		Salmonellæ (exogenous) 154	
Duration of illness	No.	%	No.	%	No.	%	No.	%	No.	%
Nil	18	5·8	19	7·0	13	12·7	23	11·7	22	*14·3*
Up to 3 days	25	8·1	22	8·1	9	8·8	11	5·6	10	6·5
4–7 days	30	9·7	46	*16·9*	11	10·8	23	*11·7*	15	9·7
7–14 days	28	9·0	24	8·8	9	8·8	17	8·6	14	9·1
Over 14 days	14	4·5	24	8·8	18	*17·7*	18	9·1	9	5·8
Fatal cases: Primary	5	1·6	3	1·1	4	*3·9*	5	2·5	1	0·6
Fatal cases: Secondary	6	1·9	2	0·8	6	*5·9*	2	1·0	3	2·0
No information	184	59·4	132	48·5	32	31·4	98	49·8	80	52·0

Salm. dublin infection appears to cause a longer period of illness and a higher proportion of fatal cases than do the other organisms. It is also not uncommon to isolate this organism from blood culture and from sites suggestive of spread via the blood stream.

Dr. R. Lovell: A few salmonella are pathogenic for man alone; some are pathogenic for animals alone but most are pathogenic for man and animals and, in this group, it is difficult to find an association between a specific type and the animal species which constitutes its reservoir. *Salm. typhimurium* and *Salm. enteritidis* are catholic types and cause a large number of the cases of human food poisoning, whereas *Salm. dublin* is associated with cattle and, at the moment, *Salm. thompson* is associated with poultry. Surveys of the type and incidence of salmonella in the different animal species are made from time to time; it is hoped thereby to reveal a picture, not only of the incidence, but of a possible pattern of the reservoirs of the different types. The pattern may exist but is obscured by the different results which are obtained, according to the geographical area and the time of year the survey is made. The frequency of actual infections, and the results obtained in surveys, may also vary according to the presence of other diseases.

It is not safe to argue from one area to another for what is true in one may be false in another. The greatest reservoir of salmonella infection in U.S.A. in 1939 was poultry; this was not true in U.K. at that time.

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In 1949 salmonella were recovered from the fæces of 1% of dogs examined in London (Cruickshank and Smith, 1949) whilst in Florida in 1952 there was a different picture. Salmonella were recovered from 15% of rectal swabs of normal dogs, from 17·9% of those in kennels, from 36·5% of greyhounds and from 87·78% of greyhounds undergoing treatment. There were 52 different serological types and many of them were also found in man. The infection was often multiple and of short duration and each greyhound had an average of three infections per month (Galton *et al.*, 1952; Stucker *et al.*, 1952).

The high frequency of infection of cattle in Wales with *Salm. dublin* is not found in other areas in U.K. In S. and W. Wales 10% of 2,552 samples of bile from cattle yielded salmonella, most of them *Salm. dublin* (Field, 1948).

The importance of concurrent infections in a given animal species is also frequently overlooked in the appraisal of the incidence of infections and of the carrier state. History teaches us that two virus diseases, swine fever and psittacosis, were at one time thought to be due to salmonella. *Salm. choleræ suis* and other types participate in the former disease and *Salm. typhimurium* has been recovered from parrots in the latter. The high mortality in relapsing fever of man in S.E. Russian areas some years before the war was associated with a concomitant infection with *Salm. paratyphi C*. A similar position confronted Giglioli (1930) when he investigated the highly fatal cases of "quinine-resistant malaria" amongst the personnel of the sugar plantations in British Guiana; *Salm. paratyphi C* was isolated from the blood of 72 of 77 patients examined. Smith and Buxton (1950) were unable to find salmonella more frequently in rectal swabs from dogs ill with distemper or hardpad, than in swabs from healthy ones; both surveys were made on dogs in the London area but salmonella was at one time frequently recovered from the tissues of dogs dead from distemper. Evidence from East Africa and South Africa has been presented showing that calves with piroplasmosis and anaplasmosis are more prone to infection with *Salm. dublin* and suffer more severely than those with one infection alone (Daubney, 1927; Henning, 1939).

The pattern of the range of host susceptibility of any given salmonella is subject to considerable change and these changes may frequently be caused by variations in diet. The high carrier rate in dogs in Florida is probably associated with the particular diet and the different types of salmonella recovered from our pigs and poultry to-day were influenced by the imported wartime diets, camp-swill and kitchen waste. If the paths of infection in salmonella food-poisoning are to be revealed then we must accept a changing pattern of host-specificity. In any enquiry therefore some consideration must be given not only to the type of salmonella involved but to those factors which may have caused a change in the pattern of host reservoir.

Few of the food-poisoning ones appear to be relatively stable in this respect and *Salm. dublin* is one in which there is an apparently limited host range. Smith and Scott (1930) demonstrated its association with calves and cow's milk; it was soon realized to be the cause of a specific calf dysentery which is known in this country, in India, and E. and S. Africa and on the European continent. Calves from one week upwards in age may be affected with a septicæmia, a hæmorrhagic enteritis and a bronchopneumonia; necrotic foci are found in the liver and kidneys. In Africa, protozoan infections, which in themselves are mild, may predispose to the disease and increase the mortality which is very variable. The acute form is rare in adult cattle except in Wales where animals of 2–6 years old are commonly affected. Such occurrences on a farm should excite suspicion as to the possible danger to man especially from milk prepared for human consumption. The dangerous animal is the symptomless and apparently healthy carrier cow, which may have no history of illness, or may have recovered from a prolonged attack. Information of such an animal may come first from the victims of food-poisoning and in 1936 an outbreak of this nature occurred in Wiltshire (Conybeare and Thornton, 1938). About 100 children were involved and the common factor was milk and *Salm. dublin* was recovered from the milk. The sera of all the cows in the suspected herd were examined for agglutinins against *Salm. dublin*; 3 of the 51 cows examined were selected for other examinations as they possessed higher levels of agglutinins. *Salm. dublin* was isolated from the fæces of one of them and this carrier cow appeared quite healthy. The reasoning for this method of approach was based on facts which are valid to-day.

(1) Normal healthy livestock possess in their sera agglutinins against many salmonella antigens; the techniques of workers vary and it is not easy or practicable to state categorically a critical titre which may be accepted as evidence of infection. It is therefore better to examine samples of blood from all the animals in the herd, and some from other herds may be included; any abnormal titres can be detected easily against this background. The labour involved is not great and most practising veterinary surgeons are expert at collecting samples of blood from many cows in a surprisingly short time.

(2) The direct examination of fæces and milk for salmonella of all the cows in a large herd is laborious and no simple screening method is sufficiently reliable to be adequate.

In this type of outbreak the milk usually becomes contaminated with infected fæces although the milk itself may be infected in acute cases. *Salm. dublin* multiplies readily in fresh raw milk stored at 15° C. and rapid multiplication also occurs in commercial grades of raw and heat-treated milk.

Pullinger and Kemp (1938) showed that strains of typhoid bacilli recently isolated from man multiplied much more rapidly in milk than did stock laboratory cultures: it may be that a variation in the rapidity of multiplication occurs with strains of other salmonella.

The elucidation of outbreaks of food-poisoning is essentially a medical problem but I suggest that such problems might yield their solution more readily if approached as detached biological problems. The pig, the cow and the sheep should be viewed as equal in importance with man and aid sought from the farming and veterinary services.

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Dr. A. M. McCall: *Salmonella infections in Somerset.*—Since 1947 there have been 14 outbreaks in Somerset due to *Salm. dublin*; 10 were bovine, 3 concerned humans and 1 was a serious outbreak among foxhounds. In addition there were 2 cases of septicæmia, 1 of which proved fatal. Of the human outbreaks 2 occurred in 1947 at Bishopsworth, Bristol, where there were 30 known cases and another at Wadeford, near Chard, where there were 29 cases. The largest outbreak occurred in 1952 in Chard and district where there were more than 600 known cases. I shall describe only the 1952 outbreak and its possible connexion with the 1947 outbreak at Wadeford.

One Friday morning at the end of September a teacher in a large school telephoned to say that there were about 100 absentees and several of the children in school were complaining of sickness and diarrhœa. I contacted general practitioners immediately, informing them of the outbreak and asking for their co-operation in sending specimens of vomit or fæces to the Public Health Laboratory, which had been warned. All schools in the area which were on the telephone were contacted and some had a number of children absent. These schools were asked to make a rapid analysis of the absentees under the following headings:

Of the number absent, those that took milk and/or dinner, those that took neither. These reports were then collected and suspicion fell upon the milk supply. Being the School Medical Officer in the area, I knew the source of the supply of school dinners and milk with the exception of two private schools, and I and my Sanitary Inspector then proceeded to follow up the milk. The dairy from which it was distributed was inspected. All employees had been well and the plant, though aged, was in good working condition and clean. It was found that the bulked milk from their farm arrived in the late afternoon, was bottled and then refrigerated overnight and left about 7.30 next morning for the various schools and for public distribution. All the milk came from one T.T. herd. We next went to the farm which was large and well conducted. The stock-yard and milking sheds were concreted and electric milking machines were used. All the employees were well and all the herd were in good shape. However, on further enquiry we discovered that one cow, Ladybird, had been removed three days previously with mastitis and was being treated in a separate building. I immediately contacted the veterinary surgeon and he re-examined the cow and stated that he now thought that it could be suffering from a salmonella infection. Samples of Ladybird's milk and fæces were sent immediately to the laboratory by road; general practitioners were informed of the possibility that the upset was due to a salmonella and all the milk was ordered to be pasteurized. The milk supply from this herd was ordered to be heat treated forthwith. By the next morning the laboratory were able to tell us they had recovered *Salm. dublin* from a sample of fæces from 2 patients and also from Ladybird's milk. All the general practitioners were again contacted and informed of the laboratory's findings and the sensitivity of this strain of salmonella to chloramphenicol was mentioned. Although there was no fear of further primary cases from this source, the possibility of secondarily infected cases was borne in mind and a letter was sent to all the schools emphasizing the importance of personal hygiene and cleanliness of the cloakrooms, and the general public was similarly advised.

Symptoms.—The order in which the symptoms presented themselves varied but all had nausea frequently followed by vomiting. Some who did not vomit had severe abdominal pain and later diarrhœa occurred in nearly every case. A fairly common and marked symptom in the early stages was very severe headache, mainly frontal, and some giddiness; very marked pallor was a striking sign. Temperatures varied from 99·5 to as high as 105 but the majority were between 100 and 102° F. Most cases recovered in three to four days. There were no deaths. Incubation varied from four to forty-eight hours but the majority were affected between twenty-four and thirty hours after taking the milk.

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TABLE I

Name of school	No. on roll	No. of children taking milk	No. of children ill	No. of school days lost	Adults affected
Buckland St. Mary	43	42	28	90	—
Chaffcombe	32	32	11	31	—
Chard Infants	135	134	43	75½	—
Chard Junior	304	240	127	243	—
Chard Grammar (Boys) ..	118	118	34	53	2
Chard Secondary Modern ..	357	133	95	229	3
Combe St. Nicholas	71	50	43	72	—
Otterford	26	26	14	14½	—
St. Gilda's Convent	210	192	82	195	3
Tatworth	99	91	84	188	1
Wambrook	17	14	14	29½	—
Whitestaunton	24	22	16	35½	—
School total	1,436	1,094	591	1,256	9
Notifications other than above			7	10	3
Total number affected	1,436	1,094	598	1,266	12

Distribution.—Some of the children affected did not take school milk but were found to have a similar supply at home or put it on a rather stodgy milk pudding supplied at the midday meal. No obvious difference in susceptibility could be noticed and there was no sex difference. Fewer older children were ill but this is accounted for by the fact that while the percentage of milk drinkers is about 90% among young children, it is only 50% in older children. The small number of adults is accounted for by the fact that few went to their doctors and the exact number is unknown.

Bacteriology.—All specimens of fæces obtained from persons suffering from symptoms of food poisoning were found to contain *Salm. dublin*. The Salmonella Reference Laboratory confirmed the identification.

Having isolated *Salm. dublin* from the milk of Ladybird it was important to discover how she had become infected. She had calved four days previously and her calf had been put on the herd nursing cow after two days. Specimens from all farm hands were negative. However, it was discovered that one of the milkers who had helped at the calving but who was on holiday during the week of the outbreak, had been infected in a similar outbreak due to the same organism on an adjacent farm in 1947. Repeated fæcal samples showed "nil pathogenic"; his blood reports suggested a past rather than a recent infection. This he was known to have had. In addition his medical practitioner discovered from his records that in September 1950 he was off work for thirteen days with a P.U.O. There was no investigation at that time but his symptoms could have fitted in with a salmonella infection. He did not respond to penicillin treatment and recovered slowly. In spite of the negative findings this man must remain under suspicion.

We looked for a link between this outbreak and the previous one, and first the possibility of a common contaminated water supply was investigated. "Moore" swabs were inserted in the water supply of both farms and all near-by streams and drains. None was positive. The remainder of the herd were examined by the Regional Veterinary Investigation Centre; milk and fæcal samples were all negative. No blood samples were taken. Ladybird's calf was found to be positive although clinically quite well. Subsequently a heifer and two cows developed symptoms and these either died or were slaughtered. The calf was treated and appeared to recover. It may be of significance that all animals affected appeared to acquire the disease in one field used annually for the local Agricultural Show and the possibility of infection persisting at the site of the latrines was considered but a few bacteriological examinations of the soil were unproductive. Another feature of this field may be of more importance: Alone of all those in use on this farm it depends for drinking water upon a brook, the River Ile at Eleighwater, which rises some two miles away and flows from the neighbourhood of the farm which was the source of the same milk-borne outbreak in 1947.

Carriers.—In one boarding school where 29 boys were affected, fæcal samples were taken from them all a month later. None was positive. It was expected that a certain number of secondary cases might occur due to healthy carriers in the day schools and in an effort to detect these "Moore" swabs were inserted in all the drains five weeks after the original outbreak. None was positive. Only one person was known to be still unfit at this time and she finally returned to work symptom-free on December 1. Three consecutive stools were free from *Salm. dublin*.

Schools.—The most serious effects of the outbreak were felt by the school population. Assuming children work a five-day week for forty weeks, it is equivalent to the loss of six years' schooling. If a week-end had not intervened it might have been necessary to close a number of schools.

Pasteurization.—Immediately following the outbreak there was a considerable falling off in the number of children taking milk but the number is slowly increasing and now is only 64 less than before

the supply was pasteurized. The fall is entirely due to parents stating they do not wish their children to take milk and there has not been one complaint by the children about the taste, &c., of the heat-treated milk.

Discussion.—In the various outbreaks in Somerset, particularly those among bovines, it has been noticed how frequently infected milk has failed to cause human infections. A possible reason is that the dose is insufficient where the milk is drunk fresh as usually occurs on a farm. However, it has also been noted, as in the outbreak described, that only one cow need be infected to cause a very large outbreak. Quite often we have found that a particular cow is not clinically ill at first although she may subsequently show all the signs of infection. Calves appear to be much more frequently infected than cows and presumably are more susceptible. At this stage they are of little danger to the public. There is probably much more infection among herds than is realized and it may be that the cows become infected, show no signs and then develop immunity. Whether this is the reason why on occasion only one cow in a herd is found to be infected, I do not know. The Regional Veterinary Investigation Department at Langford have found that antibodies in the blood were unreliable evidence of present infection or carrier state and this may be due to the fact that particular animals have been infected in the past. Field (1948) has shown that water-borne infection is frequent in cows. In Somerset, where recent emphasis has been on piped drinking water for cattle, this risk has probably been masked.

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[*March* 20, 1953]

DISCUSSION ON THE EPIDEMIOLOGY OF ACCIDENTS

Dr. W. P. D. Logan, General Register Office: *Fatal Accidents*

In his memorable Address to this Section in May 1952 our President, Professor Robert Cruickshank, reminded us that the basis of all epidemiological enquiry is the vital statistics analysed by the Registrar-General. With these encouraging words in mind I have approached the preparation of this paper somewhat experimentally, the experiment being to find out how far the routine annual statistical publications of the General Register Office assist in the epidemiological analysis of causes of death. To this end I put myself into the position of the ordinary user of these publications, that is to say I took up the latest volume of medical tables, that for 1950, and worked my way through the successive tables picking out some—but by no means all—of the items relating to fatal accidents that seemed relevant and of interest. The results of this selective survey have been condensed to ten tables which not only illustrate the kind of information that is available to anyone who likes to browse through the official statistics but also gives a broad but, I believe, useful statistical picture of the epidemiology of fatal accidents.

In token recognition, however, that all accidents are not fatal and also that our Department has recently been interesting itself greatly in morbidity statistics as well as mortality statistics, I am including an additional table giving some statistics of accidental injuries resulting in admission to hospital.

Deaths from accidental causes constitute one of the main components of the larger group of deaths from violent causes, other components being deaths by suicide, deaths by homicide and so on. In accordance with the "Sixth Revision" of the International Classification of Diseases, Injuries and Causes of Death, violent causes are classified simultaneously in two ways, first according to the external cause of the violence (given list numbers prefixed by the letter E) and secondly by the nature of the injury (given list numbers prefixed by the letter N). Thus a pedestrian who suffers the misfortune of being accidentally run over by a bus thereby sustaining a fracture of neck of femur would receive the E classification assignment E812 indicating that it was a motor vehicle traffic accident to a pedestrian, and also the N classification assignment N820, fracture of neck of femur. For some years past, coroners have been supplying us with special supplementary information about causes of death from violence in order that this dual classification can be made accurately.

In Table I, showing accidental deaths at different ages, the point to note particularly is that about

TABLE I.—FATAL ACCIDENTS. NUMBERS, RATES PER MILLION AND PROPORTIONATE RATES PER CENT OF ALL CAUSES. BY SEX AND AGE. ENGLAND AND WALES, 1950

	All ages	Under 1	1–4	5–14	15–24	25–44	45–64	65 and over
Males								
Number	8,791	440	418	605	1,182	2,075	1,906	2,165
Rate per million	415	1,232	270	201	417	316	392	1,088
Proportion % of all causes	3·4	3·6	19·0	30·6	34·4	13·6	2·8	1·4
Females								
Number	5,290	300	288	246	175	291	700	3,290
Rate per million	233	880	195	85	60	44	125	1,176
Proportion % of all causes	2·1	3·4	15·3	18·0	6·4	2·3	1·5	1·9

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one-third of all the deaths of schoolboys and young men were due to accidental causes. The corresponding proportion in girls and young women was much lower. In each sex the ages of maximum mortality from accidents were infancy and old age, but, as can be readily imagined and will be shown later, the causes at these ages were very different.

For the two age groups 5–14 and 15–24 where fatal accidents were proportionately most frequent Table II shows how the deaths from accidents compared with deaths from the other principal causes.

TABLE II.—PROPORTIONATE DEATH-RATES FROM SELECTED CAUSES PER CENT OF ALL CAUSES AT AGES 5–14 AND 15–24. BY SEX

	5–14		15–24	
	M	F	M	F
Tuberculosis	7·6	10·5	16·7	39·4
Other infectious diseases	9·7	9·8	3·9	4·5
Neoplasms	10·7	13·6	8·9	7·5
Rheumatic fever and chronic rheumatic heart disease	6·2	8·1	5·1	7·4
Pneumonia and bronchitis	6·3	6·6	2·8	3·2
Motor vehicle accidents	14·7	10·2	19·0	3·6
Other accidents	15·9	7·9	15·4	2·7

In schoolboys motor vehicle and other accidents came first, followed by neoplasms (which now include leukæmia), but in schoolgirls neoplasm and tuberculosis both exceeded motor vehicle accidents, with other accidents well down the list. For men aged 15–24 motor vehicle accidents, tuberculosis, and other accidents were the leading causes of death, in that order, whereas for young women tuberculosis completely overshadowed all other causes, and accidental deaths were relatively uncommon.

Table III compares the causes of accidental death in the two sexes at all ages. In males a third

TABLE III.—NUMBERS AND PERCENTAGE DISTRIBUTION OF DEATHS FROM VARIOUS TYPES OF ACCIDENT. BY SEX

	Male		Female	
	No.	%	No.	%
All accidents (E800–E964)	8,791	100	5,290	100
Railway accidents	331	3·8	38	0·7
Motor vehicle accidents	3,187	36·3	1,043	19·7
Other road vehicle accidents	294	3·3	95	1·8
Water transport accidents	186	2·1	3	0·1
Aircraft accidents	230	2·6	10	0·2
Accidental poisoning*	321	3·7	397	7·5
Accidental falls	1,577	17·9	2,551	48·1
Blow from falling object†	387	4·4	10	0·2
Fire, explosion, steam	266	3·0	440	8·3
Accidental mechanical obstruction and suffocation	495	5·6	315	6·0
Accidental drowning	763	8·7	200	3·8
Other accidents	754	8·6	188	3·6

*Including barbiturates 47 males, 80 females. †Male excess even in childhood:
coal gas 158 males, 248 females. Under 15—24 males, 4 females.

were due to motor vehicle accidents and a sixth to falls; and in females almost half were due to falls and a fifth to motor vehicle accidents. As the first footnote shows, the principal causes of accidental poisoning were coal gas and barbiturates, both with a large female excess. There was an enormous male excess in deaths described as due to a blow from a falling object; many of these deaths of males were occupational, but a surprising feature was that even in childhood six times as many boys were killed in this way as girls.

Death-rates at different ages from several important kinds of accident are given in Table IV. Motor

TABLE IV.—DEATH-RATES FROM VARIOUS ACCIDENTAL CAUSES, BY SEX AND AGE (RATE PER MILLION PERSONS LIVING AT EACH AGE)

	All ages	Under 1	1–4	5–14	15–24	25–44	45–64	65 and over
Male:								
Motor vehicle accidents	151	6	101	97	230	134	124	303
Accidental falls	74	25	12	16	22	32	59	476
Explosion, fire, steam	12	31	33	4	4	5	7	52
Accidental mechanical obstruction and suffocation	23	986	20	3	4	5	8	9
Drowning (except transport)	36	8	65	50	33	17	27	86
Female:								
Motor vehicle accidents	46	3	74	48	34	18	41	124
Accidental falls	113	12	11	4	2	4	28	833
Explosion, fire, steam	19	23	51	12	4	3	8	87
Accidental mechanical obstruction and suffocation	14	704	14	1	0·3	2	4	7
Drowning (except transport)	9	6	22	9	2	3	12	17

vehicle accidents and falls exerted their maximum toll among the elderly, but with the sex ratios reversed, motor vehicles causing higher rates among old men, falls among old women. Elderly people and young children, especially girls, were the chief victims of accidental burns and scalds. Accidental mechanical suffocation occurred principally in infancy, with an obvious male excess; during recent years much doubt has been raised as to whether a number, perhaps a large number, of these deaths are not in fact due to a sudden fulminating infection. A further point of interest is that the annual numbers of deaths assigned to this cause were rising rapidly until a few years ago, reaching a peak in 1947. Since then for some unaccountable reason the numbers and the infant mortality rate have been falling. Deaths from accidental drowning, excluding transport (mainly boating) accidents, were more frequent among males from infancy right up into old age.

Deaths from motor vehicle accidents and from all other accidents (Table V) were more frequent

TABLE V.—MOTOR VEHICLE ACCIDENTS AND ALL OTHER ACCIDENTS BY DENSITY AGGREGATES (USUAL RESIDENCE). DEATH-RATES PER MILLION. BY SEX

	Males		Females	
	Motor vehicle accidents	All other accidents	Motor vehicle accidents	All other accidents
Conurbations	134	232	50	182
Urban areas with population 100,000 or over	127	245	46	176
Urban areas with population 50,000–100,000	146	274	44	201
Urban areas with population under 50,000	147	293	39	203
Rural areas	205	309	47	183

amongst males living in rural areas than in large towns and conurbations but there was no evidence of a similar mortality gradient for females. No doubt there is a perfectly simple and reasonable explanation for this sex difference, but I must confess that it escapes me. The conurbations are, in the words of the official definition, "those areas of urban development where a number of separate towns have grown into each other and become linked by such factors as a common industrial or business interest, or a common centre of shopping, education, &c."

Fatal accidents are now tabulated also by where the accident occurred, at home, mine and quarry, industrial place or premises, street, institution, farm, and so on. Accidents in the home have come in for much attention lately and in Table VI I have picked out a number of accidents that occurred fairly

TABLE VI.—FATAL NON-TRANSPORT ACCIDENTS AT HOME AND ELSEWHERE. SELECTED CAUSES BY SEX

	Males		Females	
	At home	Elsewhere or not specified	At home	Elsewhere or not specified
Accidental coal gas poisoning	145	13	242	6
Falls on stairs	200	60	430	28
Fire	128	52	340	26
Hot substances, steam	48	30	61	13
Accidental mechanical obstruction and suffocation	401	94	266	49
Total (E870–E936)	1,654	2,840	2,960	1,100

frequently in the home.

Table VII deals with road accidents and shows, by a two-way presentation, the numbers of people

TABLE VII.—FATAL ROAD ACCIDENTS, CLASSIFIED BY PERSON KILLED AND TYPE OF COLLISION IF ANY

	Collision with						
Person killed	Motor vehicle, motor cycle	Tram	Pedal cycle	Other non-motor vehicle	Other object	Non-collision	Total
Occupant of motor vehicle ..	291	1	—	22	93	248*	655
Motor cyclist	696	———		184	———	178	1,058†
Pedal cyclist	555	———		199	———		754‡
Occupant of non-motor road vehicle							63
Pedestrian	1,866	26	86	15	—	—	1,993

*including 33 passengers boarding or alighting.
†including 1 male aged 80–84.
‡including 6 males aged 80–84 and 2 males aged 85 or over.

killed in various categories, e.g. pedal cyclists, pedestrians, and also what they came into collision with, if anything. Of the thousand or so motor cyclists (including passengers) who had fatal accidents, 178 were killed by falling off their cycles, or by running off the road or in some other way not involving a collision. 8 of the pedal cyclists who were killed were men over 80 years of age; and incidentally a further 8 were boys under the age of 5 years.

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The next two tables deal not with the external causes of accident but with the nature of the injuries sustained. Table VIII shows that over a quarter of the males who died from violent causes had sustained

TABLE VIII.—FATAL INJURIES DUE TO ACCIDENT, SUICIDE, OR HOMICIDE (N. CLASSIFICATION). NUMBERS OF DEATHS AND PERCENTAGE DISTRIBUTION BY SEX

	Male		Female	
	No.	%	No.	%
Fracture of skull	3,248	27·2	961	13·8
Fracture of spine and trunk	703	5·9	245	3·5
Fracture of limbs	837	7·0	1,995	28·6
Head injury (excluding fracture)	902	7·6	387	5·5
Internal injury of chest and abdomen	746	6·3	151	2·2
Lacerations and open wounds	402	3·4	94	1·3
Dislocations, sprains, contusions	66	0·6	71	1·0
Foreign body entering through orifice	271	2·3	206	2·9
Burns	257	2·2	426	6·1
Effects of poisons	1,752	14·7	1,522	21·8
Other and unspecified	2,721	22·8	926	13·3
Total	11,905	100	6,984	100

a fracture of the skull and about 15% died from poisoning. Amongst females fractures of limbs were the commonest fatal injuries, accounting for over a quarter of the total, while poisoning accounted for a fifth. Many of the deaths from poisoning were suicidal and not accidental.

Table IX shows that fracture of skull was a more frequent injury of males than of females at each

TABLE IX.—FATAL INJURIES. DEATH-RATES FROM SELECTED CAUSES (N CLASSIFICATION) BY SEX AND AGE (INCLUDING ACCIDENT, SUICIDE and HOMICIDE)

		All ages	Under 15	15–44	45–64	65 and over
Fracture of skull	M	153	83	165	159	258
	F	42	44	20	40	121
Fracture of femur	M	26	0·4	1	8	256
	F	75	0·4	0·5	8	588
Burns	M	12	14	6	8	50
	F	19	25	3	8	84
Drowning	M	58	56	37	61	154
	F	19	14	7	36	34
Drowning (excluding suicide)	M	42	56	32	31	86
	F	9	14	3	11	18

age; and that fracture of femur caused more than twice as many deaths of elderly women as of elderly men. Fatal burns were more frequent among girls than boys and among elderly women than elderly men. Drowning occurred much more often amongst males than females at each age, and from 45 years of age upwards, in each sex, suicidal and accidental drowning were responsible for approximately equal numbers of deaths.

The last table dealing with fatal accidents (Table X) combines the two methods of classification

TABLE X.—SELECTED TYPES OF FATAL ACCIDENT CLASSIFIED BY NATURE OF INJURY. PERCENTAGE DISTRIBUTION

	Motor vehicle accidents	Other transport accidents	Accidental falls
Males:			
All injuries No.	3,187	1,041	1,577
Per cent	100	100	100
Fracture of skull	61	40	31
Fracture of spine and trunk	8	5	12
Fracture of limbs	5	4	38
Head injury	12	8	11
Internal injury	11	10	3
Other injuries	3	33	5
Females:			
All injuries No.	1,043	146	2,551
Per cent	100	100	100
Fracture of skull	59	53	8
Fracture of spine and trunk	8	3	5
Fracture of limbs	7	10	74
Head injury	12	12	8
Internal injury	9	5	1
Other injuries	5	17	4

and shows what were the principal types of injuries sustained as a result of motor vehicle accidents, other transport accidents, and accidental falls. About 60% of fatal motor vehicle accidents in each

sex resulted in fracture of skull and a further 12% caused head injury without mention of fracture. Accidental falls led to a very different distribution of injuries among men and women. In men 31% of the deaths were due to fracture of skull and 38% to fracture of limb, whereas in women only 8% had fractured skull and 74% had fracture of a limb, chiefly fracture of femur.

Table XI deals with hospital cases. The figures have been taken from Dr. MacKay's report on

TABLE XI.—PERCENTAGE DISTRIBUTION OF INJURIES RESULTING FROM SELECTED TYPES OF ACCIDENTS (NOT NECESSARILY FATAL). HOSPITAL DISCHARGES, JANUARY–JUNE 1949 (MACKAY)

	Road Transport Accidents Affecting							
	Pedestrians		Pedal cyclists		Motor cyclists		Falls	
	M	F	M	F	M	F	M	F
All injuries No.	281	179	231	59	174	24	1,455	1,037
Per cent	100	100	100	100	100	100	100	100
Fracture of skull	18·1	20·6	17·3	11·9	19·6	25·0	16·5	6·9
Head injury	28·1	26·2	30·8	32·2	25·9	41·7	11·6	10·0
Fracture of spine and trunk ..	9·3	3·3	3·5	—	2·9	—	7·9	4·2
Fracture of upper limb	5·3	4·5	12·1	25·4	5·7	—	20·0	15·4
Fracture of lower limb	26·3	29·7	14·8	13·6	31·6	12·5	30·7	50·7
Dislocations and sprains	0·7	0·6	1·7	1·7	1·2	—	5·5	4·1
Internal injury	1·4	1·1	1·7	—	1·1	—	0·9	0·5
Open wounds	6·1	9·5	12·9	6·7	9·2	16·6	3·9	4·5
Superficial injuries and contusions	4·3	3·9	4·8	8·5	2·8	4·2	2·6	3·4
Other injuries	0·4	0·6	0·4	—	—	—	0·4	0·3

hospital in-patient discharges during the first half of 1949. Like the preceding table, Table XI shows the types of injury sustained as a result of certain kinds of road accidents and falls. It will be noted that, as for fatal accidents, falls led to a high proportion of fractures of skull among men and a high proportion of fractures of lower limb among women.

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Mr. William Gissane:

Some Epidemiological Aspects of Injuries

Your President, in his Address in May 1952, came to grips with the problem accidents present to modern society when he stated that the solution was to be found in team work. He suggested that the basis of all enquiry was "vital statistics", their collection and dissection he named "social pathology". He selected the team to carry out this social post-mortem: on the one hand the clinician, the morbid anatomist, the bacteriologist, the biochemist, &c., and on the other the practitioner, the medical officer of health, the statistician and the mathematician.

As I read this part of his Address I was reminded that our Birmingham Accident Hospital treatment team includes many of those he has named, and besides we have another team also based on the hospital—"a panel of research on accidents", comprising works managers, factory inspectors, trade union representatives, engineering production specialists, national and private industrial insurance officials, as well as representatives of medical research and clinical surgery. On this panel we examine the hazards in local industry—for example, from the hospital records we learn of the number of hand wounds, the agent causing the wounding and the incidence of infection of these wounds. From this study, "swarf" (very sharp pieces of waste metal produced by many types of cutting tool) was noted as being a frequent cause of hand wounds, so on to the engineer to improve methods of eliminating swarf as a hazard to workers' hands, and over to the industrial injuries insurance officials to learn the national incidence of hand wounds and their infection from this source. In this way a hospital treatment team establishes its helpful working contacts.

All this and much more besides has convinced me that the full team to cover the preventive side of accidents is a very big one indeed. Although each section of this big team must concern itself with the minutiæ of its work and pursue its own objectives in private, the team should at frequent stages "get together" to discuss the full problem. One of the outstanding difficulties in this "team conception" is so to streamline the team that it really does work as a team rather than as a collection of disjointed specialists. This is by no means easy in the field of medicine but it can be achieved.

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I have seen team work at its highest level of efficiency in an immense factory making mass production motor cars. The team includes high level specialists in all engineering fields and takes in the conveyor belt workers. In such an organization a new model car is planned in every detail and it is assembled with every modern engineering aid. Finally it is tested by expert drivers over the mountains and the valleys of Europe and the climates of Norway and Africa. On paper the end-result should indeed be superb. Yet I have owned for many years cars of this firm's make. On asking why they were not superb, two reasons were given. First that the planning and assembly team were capable of mistakes, and secondly, however exacting the tests a new model was submitted to by their experienced drivers, the firm never learned the real weaknesses of a new model until the owner driver had done his worst to it over a period of a few years! In this story is a lesson for all to learn in accident prevention. However well we may plan on our carefully collected evidence, that plan is to be finally implemented by the people, and they are capable of astonishing behaviour.

For example, some years ago I was very disturbed by extensive scalping injuries to young girls whose hair had been caught in moving belts at their place of work. Surely there must be a way to protect the hair of women workers, and so I visited many factories. At one big works I saw a display cabinet showing models with several styles of very attractive protective head-wear. The management insisted that all workers under hazard should wear one of these styles but the choice remained with the worker. Walking through the adjoining production shop I noticed that not one of the several hundred girl workers had her hair completely covered. The reason? They gave it to me very readily—they were much more interested in their appearance than in their safety. The same sort of human behaviour of men and women is seen with safety guards covering potentially dangerous production machinery. They are often put out of action by the workers themselves, and the reason? They slow up production and therefore decrease the pay packet. This evidence of peculiar human behaviour is seen in all types of domestic, industrial and road traffic accidents. People are not impressed by the evidence of the statistician alone. We must in other ways influence their behaviour.

There is hardly an aspect of human activity entirely free of responsibility for accident prevention—housing, road and town planning and, perhaps most important of all, education. The fact that home accidents outnumber both industrial and road traffic accidents, and that 81% of the victims are housewives, children under 14 and the old, suggests very strongly that there is yet a great deal to be done first in spreading this little known fact and then in instituting safety measures in the home, and in improving the standard of home safety behaviour.

Half of the accidents I have treated over the last twenty years were preventable, either by better behaviour on the part of the victim, the individual causing the accident, or by both. Leonard Colebrook's statistical evidence concerning thermal injuries in the home confirms this impression.

The pity is that this knowledge is well known to those on the research and treatment side of the accident team and too little known to those who would most benefit from this knowledge.

Accidents are more frequent in well-populated countries where mechanization of industry and transport are developed to a very high level of efficiency. In our population of 50 million people, 1¼ million are injured each year seriously enough to seek hospital treatment, and over 10 thousand are killed. In the U.S.A. 100 thousand are killed each year and 10 millions are injured. As a cause of death among working age males, accidental injuries are outnumbered only by heart disease and cancer. In the U.S.A. industrial injuries alone account for 16 thousand deaths annually and for every fatal occupational injury there are 125 non-fatal injuries.

These losses place a heavy load on family life, amenities and finance. Accumulated they place a terrific burden upon the productive power of a country. For example, 46 million working days were lost in 1945 in the U.S.A. from industrial injuries alone.

To bring figures down to the level of understanding, our small Birmingham hospital treats 50 thousand fresh accidents each year. 61% of them occur in working-age males with an average age of 35 (that is, each of these workers has thirty years' expectancy of working life ahead). In a few weeks we treat over 500 such working men and so our treatment influences, for better or for worse, 15 thousand years of working life in this group over each short period of a few weeks' intake.

Certain features of orthodox epidemiological theory can be transferred direct to the study of accidents. The virulence of the noxious agent applies equally to the bacterium as to the type of road traffic vehicle, the production machine or the inflammable nature of clothing fabrics in domestic burning accidents.

The introduction of a new virulent agent or combination of agents may cause an epidemic of accidents. For example, open gas and electric fires, together with a change of fashion in clothes—for example, the present trend to the crinoline, perhaps made of very inflammable fabric—may cause an epidemic of burning injuries in the home.

The resistance of the host has its equivalent in the varying liabilities to accidents in different stages of training and in different age groups. Particularly worthy of study, because this has not been done,

is the relationship of trivial accidents resulting in serious and permanent disabilities in ageing men, who for long years have worked under all types of heavy physical strain. For example, the backs and the knees of the coal face worker after years of cramped work are after trivial injuries just as likely to break down permanently as the much publicized heart of the high-pressure business executive.

The population at risk can be computed for different types of accidents. For example, the number of workers in industry and the number of their accidents; the number of road users and the number of their accidents.

Crowding is an important factor in the study of both infectious disease and accidental injury. Crowding affects accidents in two ways. First, there is less space to perform an activity—for example, there is much more danger of the worker hurting himself in a workshop overcrowded with machinery than in a well-planned workshop; there is much more danger to the housewife in a very small, overcrowded and ill-planned kitchen than in one well planned and with safety kitchen fitments. Secondly, there is more danger of involving other persons in accidents where human crowding is a big factor, for example, congestion on our roads.

There are many similar matters worthy of close study in the field of epidemiology.

As a clinician I am much more interested in another side of epidemiological study in accidents. This covers the organization necessary adequately to meet the problem of diagnosis and of treatment of the immense numbers of injuries coming to our hospitals each year—over 1¼ millions. This is almost exclusively a medical field of study, but it is not a problem to be solved by clinical study alone, nor to be left to clinicians alone. Yet its solution could result in immense benefits to the community and an improvement in the easier management of our hospitals generally.

Diagnosis and treatment in the care of accidents is a very broad issue and it is not yet resolved. The present clinical dilemma has perhaps been brought about by the growth and general acceptance of specialization within surgery. By specialization the body has been divided into certain well-defined anatomical regions. There is a great deal to be said in favour of specialization; we find examples of it in every field of human endeavour. New knowledge is much more easily won by concentrated study in special fields. Yet the approach of the specialist is slow and careful, well arranged and premeditated, the passage of time is a secondary consideration, a matter of no importance at all as compared with accuracy.

In the care of the acutely injured, time is a primary consideration; the consequences of delay in the treatment of the injured can be, and often are, disastrous. To quote Dr. Henry Beecher in a consideration of serious injuries written at a casualty clearing station: "The enemy has produced the worst wound he could and its consequences are cumulative: dehydration, increased fluid loss in sweat and vomitus, continuing hæmorrhage or plasma loss, pain—making rest impossible, increasing emotional exhaustion, developing infection—these and other factors are set in motion by the initial wounding. Their progress is to be checked only by surgery or by death."

This is an accurate picture. For all wounds delay in diagnosis and treatment allows time for the development of a group of pathological changes—shock, infection and scarring leading to deformity—all nowadays much more easy to prevent than cure.

The medical and surgical problem presented by injury is therefore divisible into two phases. First, the injury without complications. Secondly, the injury plus complications ensuing as a consequence of delayed treatment.

Further study is required, more information is needed, before it can be said categorically that the diagnosis and treatment of injury fall easily and naturally into the present hospital organization of any surgical specialty or group of specialties.

The surgical requirements of injury, I believe, demand for their solution an altogether different surgical timing and a completely different hospital organization than is now accepted by specialist surgery. An organization that is aimed primarily at the prevention of the known complications following injury and an organization that is geared to meet such emergency commitments to vast numbers of patients.

In recent years, I have been much impressed not only by the value of early and adequate blood transfusion for severe injuries, and for equally early and adequate plasma transfusion for very extensive burns (and for the need of a twenty-four-hour day laboratory team to render such a transfusion service absolutely safe), but I have been even more impressed with the surgical problems these life-saving measures help to solve. Transfusion is only a means in severe injury of prolonging life, it is not an end in itself, to it must be added surgery and emergency surgery of a very high level of efficiency and covering a very general field. Into the group of severe injuries come the worst types of thoracic, abdominal and head injuries and, more frequently, the most severe, often multiple injuries to the locomotor system, injuries about which even specialists in these chosen fields are still unfamiliar. The clinician responsible for the care of such patients will often be at his wits' end to make sure of his surgical priorities, for obviously such patients cannot at once withstand the repair of all their injuries.

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Yet it is all-important that a clinician decides quickly on the injury requiring immediate surgery and recognizes those with which he may temporize. Here indeed is a problem in emergency surgical organization in this age of specialization, a problem brought about by our excellent ambulance and transfusion services.

In thermal injuries 40%, 50% or 60% body area burns can now be brought through the shock phase, but there are still ahead weeks of dressings and skin grafting before such patients are "out of the wood," requiring a ward, wound-dressing and theatre organization to prevent infection or to keep it down to its minimum, that has previously been undreamed of in surgical practice.

With our increasing knowledge concerning the details of traumatic anatomy of all wounds, the field of very early open operative repair of the common injuries is quickly expanding and with it the need for better protection against infection in our operating theatres.

To Leonard Colebrook and Bourdillon operative surgery owes a great debt for their work on air sterilization. When this is added to operating theatre equipment then we will at last have captured the completely clean operating theatre.

This sort of clinical and research evidence and much more beside, has convinced me that an individual hospital staff developed exclusively for the treatment of injury is essential in every area of heavy population, if medicine is to lead the way in combating the present social problems that accidents present. But this matter needs further proof before it is generally accepted and it may well appeal to this section as a worth-while field for study.

Such hospitals would be staffed not only by a treatment team devoted exclusively to accident work, clinicians, first-class anæsthetists, nurses, morbid anatomists, bacteriologists, biochemists, transfusion laboratory team, rehabilitation staff, but with yet another team to study vital statistics, the social pathology of the locality in relation to accidents in that community. If such teams worked together they could do much good in improving the behaviour of the local community.

The practical difficulties in achieving such a hospital organization for accidents are very obvious. At present there are over 1,000 hospitals in this country concerned in the treatment of accidents, the majority of them poorly equipped for the care of accidents, and all experiencing very real difficulty in attracting any type of resident surgical staff.

As far as our experiment in Birmingham has gone, there is clear evidence that there are definite and real advantages in segregating serious accidents to fewer centres for acute treatment. Then it not only becomes economically possible to erect adequate treatment facilities for the injured, but, equally important, the surgical experience to be gained in large units has proved attractive to young graduates.

Good teaching in both the diagnosis and treatment of acute injury would be developed much further by attaching each large accident unit to a medical school. There is no field in medicine presenting better and wider opportunities for sound practical training in the basic sciences of bacteriology, anatomy and physiology, and indeed, in preventable pathology, than the treatment of accidents.

There is also a need to link accident units with established specialist surgery—the practical link of an accident unit with plastic surgery, neurosurgery and thoracic surgery has two great advantages, first in keeping the accident service up to date in specialist practice, and next in giving to the specialists experience in the acute accident field of their work that they would not otherwise gain.

The challenge and the reality of a national hospital service has been with us for five years. Medical men, whatever their field, must lead this service into an organization that will meet the reasonable treatment needs of all the people. Among our major treatment problems, accidents stand very high and particularly so with the otherwise healthy and productive members of our community.

Section of the History of Medicine

President—

The Right Hon. Lord WEBB-JOHNSON, K.C.V.O., C.B.E., D.S.O., T.D., M.B., F.R.C.S., LL.D.

[*November* 5, 1952]

James Rae 1716–1791

By Professor JOHN BOYES, F.R.C.S.Ed.

JAMES RAE was born in Edinburgh in 1716 and died in 1791. He was a descendant of an old Stirlingshire family. On August 27, 1747, he became a member of the Incorporation of Surgeons and in 1764–65 he was Deacon (President). On July 7, 1766, he was appointed the first surgeon to the Royal Infirmary and commenced practical discourses on the cases under his care. As a result of the success of these lectures the surgeons made a determined attempt to establish a Chair of Surgery in the University of Edinburgh and to have Rae appointed the first Professor. Munro Secundus, however, defeated the proposal and afterwards had the title of his Chair changed from that of Anatomy to Anatomy and Surgery. D'Arcy Power in his article in the *Dictionary of National Biography* says "Rae did in the Scottish Metropolis what Percival Pott did in London; he established the teaching of clinical surgery on a firm, broad platform".

"Rae married in 1744, Isobel, daughter of Ludovic Cant of Thurstan in East Lothian. By her he had two sons and several daughters. The elder son William joined the Incorporation of Surgeons on July 18, 1777, settled in London and died young. John, the younger brother, was the first Fellow of the Royal College of Surgeons of Edinburgh where he was admitted on March 14, 1781. He became President in 1804–5 and was well known in Edinburgh as a dentist. Among Rae's daughters was Isabella, wife of James Fleming of Kirkcaldy, whose daughter was immortalized by Dr. James Rae as 'Pet Marjorie'." This made clear the relationship between William Rae and James Rae but said nothing of the lectures in dentistry and I was unable to find any reference to them in the Edinburgh newspapers for 1764. But the *Minute Book of the Incorporation of Surgeons* contains the following entry:

> " 24th January 1764. Mr. Rae informed the meeting that he proposed giving a course of lectures upon Diseases of the Teeth and desired the Corporation would be pleased to allow him the use of their Hall for the purpose which was unanimously agreed to."

This seemed to prove beyond any doubt that the first course of lectures in dentistry in Britain was given in Edinburgh in 1764.

JAMES RAE AND THE INCORPORATION OF SURGEONS

In 1741 there was an entry in the Minute Book dated August 25 stating that he was apprenticed to Robert Hope. Almost a year later, July 25, his name occurs again when, owing to the death of Robert Hope, he was apprenticed to a new master, George Lauder. He petitioned the Incorporation on May 27, 1747, for admission as member of the Corporation. In view of the fact that there was upwards of two years to run of the eight years since the date of his indentures, he was required to pay fifty pounds "which he having agreed to do therefore appointed him for his first lesson, general questions in surgery with a discourse thereon or upon Anatomy and this day four weeks for the time thereof and nominated Dr. George Young, Alexander Munro, John Campbell, James Russell to be his examinators".

"*17th June*, 1747: This being James Rae's first lesson he discoursed upon one anatomical description of the pleura and mediastinum. After examination the Corporation appointed him for his second lesson, the contained parts of the thorax and this day four weeks for the date thereof."

"*15th July*, 1747: This being James Rae's second lesson after examination the Corporation appointed him for his third lesson, Botany Materia Medica, Reading and explaining receipts with the Methodus Componendi and this day four weeks for the time thereof."

"*12th August*, 1747: This being James Rae's third lesson after examination the Corporation appointed him for his last lesson—the operation of amputation with the proper dressings Unguentum Diathea and emplastrum Denudiæ cum sapone and this day four weeks for the time thereof."

"*27th August*, 1747: This being James Rae's last lesson after examination a vote was taken approving the qualification of the said James Rae and it being carried in the affirmative Nemo Contradicente and therefore in consideration thereof and of his having paid the Treasurer the sum of £55 sterling money (being the sum appointed by the Corporation to be paid by him) as his entrance money the Corporation admitted and received the said James Rae to be Freeman Surgeon."

It was always the habit for the surgeons to entertain the new member of their Corporation and that James Rae was suitably entertained is recorded in the Minutes by the fact that at the next

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meeting James Kennedy paid a late subscription of 2s. 6d. towards the cost of it. Another habit of the surgeons was that four examiners were appointed to examine new candidates and of these four two were senior and two junior members. In 1749 Rae appears as a junior examiner and on the second occasion in that year it is recorded that Alexander Brown was examined and he discoursed upon the teeth. On no other occasion in quite a wide survey of the subjects of anatomy that are recorded did teeth feature as the main subject of the examination. Does this indicate that by 1749 Rae was already interested in the teeth?

In 1754 he was appointed Auditor of Accounts. Two years later he was Librarian. From 1760–64 he held the office of Treasurer and in 1762 was representative of the Corporation of the City of Edinburgh Charity Workhouse. The following year he was a member of the Committee which negotiated the transfer of the Surgeons' Library to the University of Edinburgh. On September 15, 1764, he was elected Deacon and on the following year he was re-elected to this office. At the age of 50 in 1766 he was appointed Surgeon in Ordinary to the Edinburgh Infirmary.

"*4th April*, 1770: It being mentioned by one of the members that the taking of students to attend shops is of very bad consequences to the Society but more particularly to their apprentices, these gentlemen students being under no sort of restraint; they take liberties which give the very worst example to the prentices. All the members present agreed that this was most certainly true."

"Mr. Rae observed that the Gentlemen who served for freedom had not a title to enter with the Corporation till eight years after the date of their indentures without paying £100 Scots for each year short of that time while those who had no title could purchase freedom for £1,000 Scots. That as this was in his opinion most unfair to the prentices he proposed that every person who had no title other than purchase should pay in place of the £1,000 Scots Two Hundred Pounds sterling. That the interest of that sum with what the Corporation could afford to give would help to maintain the widow and children in case they should have occasion for it."

"27*th August*, 1772: The Gentlemen named in the Minutes of the 7th August for meeting with Mr. Rae on the plan relating to his publick lectures on Surgery having accordingly met with him and produced to the meeting the following advertisement which having been publickly read to the Corporation they approved therefore and ordered the same to be advertised in the publick papers. The tenor of which advertisement follows: The College of Surgeons being desirous to provide every useful understanding towards the advancement of the knowledge of surgery have taken into their consideration a plan of lectures on the whole Art of Surgery also practical cases of importance as they occur in the Royal Infirmary given for several years past at their Hall by James Rae, Surgeon in Edinburgh and one of the members of the Society as this course is founded on the practice of the hospital and delivered by a person who has been in the habit of constant observation they recommend it as useful and necessary to the students of Physick and Surgery and to render this course more extensively useful the Society are resolved to communicate to him such cases of importance as may occur in the practice."

"23*rd October*, 1776: The following letter was produced by Mr. James Rae and read to the Society:

'Gentlemen: The polite and liberal treatment I have always received from you . . . induces me to lay before you a proposal I have some time had in view which is that the Society would please to frame an application to His Majesty for the Royal Sanction Establishing a Professorship of Surgery in the University of Edinburgh as necessary and useful towards perfecting the students of medicine and surgery in this branch of their education.

'Permit me to mention with pleasure the constant attention you have paid to whatever appeared to increase the knowledge of this most useful art—the early care you took of the Royal Infirmary by supporting it from your own liberality when it had scarce any friends, the giving of medicines (gratis) both before and a considerable time after the building of the present noble fabrick, the succe s I have all along witnessed (the natural effect of your humane and judicious management) must strike every person interested in the good of the hospital as it does me with heartfelt satisfaction. The great number of Students attending the hospital at an expense trifling when compared with what is paid at other hospitals, and in place of taking any part of the sum paid by them for their admission your generously allowing it to be added to the common funds of the Hospital is proof amongst others of your disinterested attention to everything that may promote the study of the arts.

'The students sensible of the advantages they reaped from clinical lectures which were originally set on foot by the worthy Professor Dr. John Rutherford and ever since continued to be given at the Hospital by the Medical Professors on the medical patients solicited me several years ago to undertake practical lectures on the chyrurgical patients adopting the same method from this they proposed to reap advantage. As I had been long before this giving a course of lectures on Surgery I judged the proposal a reasonable one and that it might be most beneficial to the students. I accordingly laid this matter before your Society. I had the satisfaction to find it received the universal approbation. You were pleased to apply immediately by a memorial to the honorable managers of the Royal Infirmary for their assent to prosecute the plan of clinical lectures on Surgery. This they most readily granted and these worthy Patrons at your recommendation did me the honour of thinking me fit to take that important charge.

'The constant opportunities you have put in my power of reaping advantage from your free

conversation on matters relative to my lectures, the supplying me with materials suiting my plan, the candid remarks on the cases of importance occurring in your private practice, particular circumstances attending operations, the effects of medicines whether internal or external remedies in courses of cures, the presents I have received of useful preparations from different members of the Society, all these lay me under the greatest obligation to my Brethren. As the Society will never propose any measure relative to the improvement of this art but what they would naturally expect should meet with public approbation, I hope it will be their pleasure to frame such a memorial for this purpose to be laid before the honourable Lord Provost, Magistrates and Council to adopt measures necessary for having a Professorship of Surgery on the practical system established with the College of Edinburgh. I further beg leave to observe that I understand that Dr. Munro hearing that an application was included for having a Professorship of practical surgery established has taken some alarm apprehending it may be detrimental to him as Professor of Anatomy and has got the Brethren of the College in a Faculty Meeting to give their opinion of the inutility of such a Professor as he teaches all that students could learn from it. I therefore submit to you Gentlemen whether it is not proper for you to take that matter under consideration and if you are of the opinion that it has no direct interference with Dr. Munro and will be of advantage to the students in matters which he does not teach or profess, that you will make your opinion known to the Honourable Magistrates and Council'."

James Rae and His Family

Two sources of information earlier to D'Arcy Power's contribution are John Kay's *Edinburgh Portraits* (1885) and an article in *The Scotsman*, April 4, 1888, "An Old Grave", written by Rae's great-grandson Dr. George Gibson. In Kay, Rae is said to have been considered a talented and experienced surgeon and had a large practice. "He obtained much reputation as a dentist."

In a footnote to the above article it mentions that he lived in a house at Castle Hill on the site of which a school now stands. After Rae's death it was purchased by the Society of Antiquaries. I was pleased to discover in this connexion a reference to the Society and the purchase of Rae's house. It was stated that Castle Hill house was much more suited to the needs of the Society for ladies could descend from a sedan chair and step into the Society's house whereas the previous headquarters were down a muddy close and ladies wishing to visit the museum had no other means of gaining admission to it than to walk through the mud and so the receipts of the Society were low as visitors to the museum were few. If this picturesque tale were only true! But the real reason was financial and the move to Castle Hill involved a saving of money and, in fact, the executors of James Rae were very generous and allowed extra time for completion of the purchase of the house. To-day if one climbs the grassy slopes of the Castle near the statue of Earl Haig on the Esplanade, one can discover a large stone with ancient inscriptions, the last remaining relic of the Antiquaries Museum in Rae's house. It was too big to display in the house itself and was deposited on the grass near-by. The Secretary of the Society still climbs the grassy hill and inspects it from time to time!

During a search of the local newspapers published in 1764 I came across the following advertisement:

"House at the foot of Rae's Close to let. A House at the foot of Rae's Close, north side of the head of the Cannongate consisting of three floors besides cellars. There are three rooms and a kitchen on the first floor, 4 rooms on the second floor and five garret rooms, two of which have chimneys on the upper floor, with many closets, 3 good cellars, a stable and a well. The whole is within a gate between which and the house there is a large yard or entry planted with trees and behind the house there is a small garden with fruit trees and flowers in it. The house is fit either to be divided or possessed altogether by one family but if application is not soon made for the whole lot, rent only £25 sterling, the property will be let off in lots" (*Caledonian Mercury*, March 3, 1764).

It may have been the house in which Rae was born if it is correct that Edinburgh was his birthplace. I have been unable to find proof of this. Rae's father was a writer but it is his grandfather, James Rae, that has interest for us. He bought the ground and built the house, called Rae's Land which was approached by Rae's Close. He was a Bailie of the Cannongate and Miss Armitt, Assistant Archivist of Edinburgh, gave me the information that Rae was given permission on June 9, 1686, to build "bath stoves" (public baths) and was given the monopoly for seven years. These were the first public baths built in Edinburgh. However, the fact that most interests us is that he was a barber and in 1662 was appointed Barber to His Majesty Charles II. Is this the origin of Rae's interest in teeth? Rae, His Majesty's Barber, would have been involved in discussions with the barbers, the surgeons and the Town Council of Edinburgh which took place in 1682. The Town Council Records of July 26 of that year record that consideration was given to "the great scarcity of good and qualified persons within the City whoe have skill to trim and barbarize and that a considerable number of the inhabitants are forced to goe to the suburbs to be trimed as lykenwayes it has occasioned many complaints to be made by noblemen and others resorting to the towne that they cannot be conveniently served by persons of that imployment within the towne and to the effect the leidges may not have sufficient ground to clamour upon that accompt. Therfoir they recommend it to the deacon and Incorporation of the Chirurgions to take some effectual course that the Cittie be furnished with a compitent and suitable number of persons skilled in the airt of cutting hair and taking off of beards".

Rae's family with exception of his father and grandfather are buried in the kirkyard of the old kirk of the Greyfriars. I visited the tomb and noted the long list of names of the family who are

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interred there. When I left this old historic place it seemed a fitting close to my searches. My mind wandered over Scottish history to Mary Queen of Scots who gave the ground to be a graveyard; to Charles I who received the National Covenant signed there; to Charles II and his barber; to Charles III,—there is, of course, none, but there was Bonnie Prince Charlie and the '45. Then it occurred to me that James Rae was in Edinburgh during the Jacobite control of the city. What were his reactions to this? A search failed to reveal any direct contact but his master, George Lauder, featured prominently.

My search has led me to many places and I have been helped by many people: in particular, Miss Armitt, Assistant Archivist of Edinburgh, Miss Brown, Librarian at the College of Surgeons of Edinburgh, Mr. J. C. Young, Secretary to the Registrar of Births, Deaths and Marriages, Edinburgh, Dr. C. A. Malcolm of the Signet Library and the Assistants at the Edinburgh Room of the Edinburgh Central Library. I am grateful to the President and Council of the Royal College of Surgeons of Edinburgh for permission to quote from the Minutes of the Incorporation of Surgeons.

[*March* 4, 1953]

The Value and Significance of Representational Painting, Especially in Regard to History

By Sir GERALD KELLY, P.R.A., LL.D.

SIR GERALD KELLY opened his lecture by saying: I want to talk to you about the subject in which I take most interest, namely painting, that is to say, representational painting. I am 74, and therefore it is evident that I am slightly past my middle age, and I do not suppose that I shall see another 74 years, but by the end of that time there may not be many people alive who would wish to talk about representational painting because the subject will have lost interest. It is, I think, so much easier to design triangles and yellow squares and call the result a portrait of my aunt, and if you could see my aunt you would know that I was right!

Without being too frightfully pompous, I want to try and explain to you what it is that the representational painter tries to do. When people started to make pictures they did not analyse what it was they sought when they looked at an object. They just went up to the object whatever it might be —an orange, a house, a river, a woman—and painted it. If they painted the Virgin Mary they may have taken as a model their best girl. But they took a lot of trouble about it and they made out what might be called a catalogue of the object in question. You may see the pictures of the Virgin Mary and the cradle and the little Child and if you are looking at a Leonardo da Vinci you will get a wonderful picture of the Virgin Mary and the Child. The drawing of the figures is exquisite, the design is wonderful, and as you look at each item in the composition you recognize what the object is. All details are sharply defined, as if examined separately. Leonardo's restless mind was never contented. He redesigned his pictures again and again.

But the "representational painting" I am talking about is a different thing. It is using paint to describe the impression of things seen, something which has moved you so much that you want either to share the pleasure with others or to make the magic of it permanent on canvas.

Without insisting that a representational painter may be intellectual (for modern critics insist that they are not) I do claim that representational painters are strangely moved by the beauty which God has provided and which we meet in the world as our eyes look around. They (representational painters) are subject to the same kind of accident that befell St. Paul on his way to Damascus. The beauty of something overwhelms them.

That, of course, is a highly coloured version of what happens to a representational painter when he decides to paint a picture. From the moment of such decision he has to obey a certain scheme: he has to conform to what happens in his mind. If you see a pretty lady or a pleasant object you see it because the light is coming from somewhere and the shadows are being formed, and since our eyes can only record what appears at the moment, the eye has to hold and bind the thing together until you get it fixed in the painting. Let me try to put it again: Suppose you see an object quite close to you which is round in shape, orange in colour, and smells like an orange, you know that it is an orange; but if a row of such objects were placed at an increasing distance away you would not see the most distant ones as oranges. They would, from your point of view as a representational painter, not be oranges at all. So the representational painter is trying to explain what it is that he sees as the light is reflected into his eye. You are able, if you are competent enough (like one of the Dutch painters whose work was recently on view at Burlington House), to recognize the difference between a piece of sacking and a blanket simply by the manner in which one or the other object reflects the light. All representational painting consists of recording the relative amount of light reflected into the eye, and such painters as Jan Vermeer van Delft are doing just that. There was a French painter named Chardin who painted marvellous pictures of pots and pans and in the same way Velazquez painted Kings and Queens and he managed to produce magical beauty by means of a straight representation of this rendering of light. Velazquez more than any painter who has ever

lived was able to do this. He had the eye that could not be contaminated by experience. You remember that story of our Blessed Lord restoring sight to the man who had been blind from birth, and after the miracle the correspondent of a local paper went up to the man and asked him what he saw—the sort of thing any journalist would ask. The man replied that he saw men as trees walking. I am not quite certain what it means. He was frightfully muddled, but he saw some things moving, and others static, and the only thing he could think of was that the men walked and the trees stood still. So thrilled was he with what he recognized, and the same was true of Velazquez who put down in paint what he saw, just as he saw it, and each time a pattern of colour and light came to him he recorded it with the awful sincerity and the beautiful innocence of a small child.

I want to show some lantern slides of the pictures of Velazquez. The first one I have put in the lantern deliberately upside down. I have done so in order that you may share in the simplicity of the Velazquez vision. What he is looking at he records and he could have recorded it equally well had it been upside down. The subject in this instance is a chair with an adorable little dog and there is the hand of a child on the chair. Those of you who have studied that hand must be aware how lovely it is. The subject offered Velazquez his opportunity to put down just what he was seeing and not what he knew to be there.

In another picture of the same kind notice how the thumb is almost entirely hidden under the separated fingers. Velazquez was perfectly content to put down that rudimentary version of the thumb. And here again I show you the picture turned upside down, and suggest to you that Velazquez could have painted it in that way just as well as in the other.

Any painter, other than Velazquez, would have put down a little more than he saw, would have indicated the structure of the fingers, but Velazquez put down exactly what he saw, with innocent veracity. Now I show you a very large picture called the "Tapestry Weavers". It represents a corner of the workshop. In the foreground is a lovely girl winding the wool and to the left of her an older woman spinning her thread. Do you notice the wheel going round? Then we have in the background of the picture two ladies of fashion. I assure you that this painting is so true that when you stand in front of it you can feel yourself in the century in which Velazquez lived—the seventeenth—and you feel that at any moment you could walk round and talk to the people pictured there.

I want now to show you a whole group of Velazquez paintings representing dwarfs about the Court. Here we have the portrait of an angry little man, a dwarf with his little feet stretched out towards you. I draw your attention to the rudimentary way in which his hands seem to be depicted. Velazquez saw no more of them than that, and what he saw he put down in paint. In another dwarf this audience will not need to be told from his appearance that he is syphilitic and is suffering from hydrocephalus—he is an awful creature. But out of such material Velazquez made an exquisite picture. I draw your attention in particular to his right hand. He is holding a pack of playing cards. Do you notice that if a player to-day took up a pack of cards that is exactly the way in which he would hold them? Need I say much more about the thrill one gets from Velazquez? A very eminent man once said to me, "You know, Gerald, recognition is not an æsthetic emotion". That gave me a jolt, but in a moment I recovered for, after all, I *had* experienced keen and delightful emotion and it did not really matter to me that it should not be classed as æsthetic. So when you go home, you can say that you have recognized certain objects like hands and dogs in the photograph of a painting, but you recognize that though it is rather a pleasure to do so it is not an æsthetic one. Here we have another marvellous portrait of Pope Innocent X. The subject has a red face and a greasy skin and Velazquez makes a wonderful pattern out of it. Next there is a picture about which I am going to give you the story. It is a very big picture and if it were by anyone else would be termed a sketch. It is called "The Maids of Honour". To the left of the picture you see the back of a big canvas, which is the very canvas on which this picture is being painted; you see Velazquez himself, standing back in front of this canvas, and in the foreground the little Infanta, with a Lady of Honour between her and Velazquez on her knees offering a little scarlet bottle on a salver. There is a second Maid of Honour on her other side. In the shadowy background there are several figures, a duenna, and to the right, in the foreground, there are two dwarfs and a dog. Of course the Maids of Honour are Ladies of great family and in elegant clothes, but they are not remarkable for beauty and the composition is a very odd one. But I feel sure that this is one of the most marvellous pictures in the world. Many times I have seen it and I have spent hours in front of it, and among those who have come and looked at it I have never heard any expression of disappointment. I believe it has pleased everybody who has seen it. When I was a small boy I used to imagine myself turned into a bluebottle, and in contemplating this picture I thought of that and imagined myself a bluebottle and buzzed off into the picture and flew about climbing up and down, and in my reverie I was loth to come out. About three years afterwards I was in front of that same picture and one of those very old ladies one meets in picture galleries came up and said to her companion, "There is a story of a man who found himself changed into a bluebottle and got into this picture frame and was never able to get out." I beg of you, if you ever find yourself in front of this picture, take care what you do.

I come next to some pictures by Franz Hals who did not have the beautiful vision of Velazquez. But he painted admirably and realistically. I have only to call your attention to the marvellous drawing of the hands, in particular of the thumb, in this picture. Next I show you a Rembrandt.

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I need not tell you why I like it. I should include it if I were asked to choose the ten finest portraits in the world. It is one of the pictures you cannot forget.

I will show you a portrait of an ugly young woman by Vermeer which is a miracle of beauty. I don't know how!

In all these examples I show you it is always the same story, the light revealing something delightful and the artist being content to depict it exactly as he saw it, and thereby to afford the pleasure of it to his fellows. In spite of all the awful things you have heard about painters, some of them are extremely delightful people and they are eager to allow you to share in the result of their gift. Again I call your attention to the extraordinary ingenuity with which the hands in particular are managed in these pictures. The hand of a lady weighing some article of gold or pearls—I do not know what it is.

Then we have a picture by Chardin again in the representational style. It shows a young man cleaning out dregs of wine from a leather bottle, and out of that particularly ugly boy and a few incidentals Chardin has made something memorable. In the same way there is this picture of a woman polishing a frying pan—almost a perfect picture, with admirable drawing. I bid you notice how her left hand holds the handle of the pan.

Then we have some pictures of still life, and these again have a beauty of their own.

My aim in talking to you is to explain how the relative amount of light reflected from visible objects into our eyes gives the painter the chance of representing the third dimension, and perhaps the next time you look at pictures you will see something of what he saw and that will give you pleasure. The idea that because cultured and distinguished minds have admired Michelangelo you ought to like Michelangelo is the most awful poppycock. Do not bother about Culture. I do not wish to sneer at your culture, it may be good, but the important thing is for you to enjoy a work of art, then that work of art, be it painted, or poetry, or music, has justified itself by the thrill and entertainment it has given.

Years ago I had a great friend who, unfortunately, died. He was, in my opinion, a painter of the highest class. His pictures were almost entirely unknown. He used to choose a scene which he interpreted in a very simple way; he got the right colour and he put it in the right place. He painted a few portraits, admirable ones, but for the most part he was content to paint still life all the time. He and I planned to produce a book together about painting. He was going to write about the observation and mixing of tones and my share was to have been the technical processes of painting a picture. The book never materialized, but some time after his death his widow sent me some of his notes and there is among them a passage so brief, so completely sensible that I will read it to you:

"The act of painting consists in the application of paint to canvas. Only when the brush is in contact with the canvas is the painter actually functioning, so to speak; and this contact or movement of the brush on the canvas is an act of drawing. Drawing, therefore, is the only thing which is actually happening during the moments when the picture is coming into existence on the canvas. Everything else the painter does in connexion with his picture is in the nature of preparation. To use a military analogy, composition may be likened to strategy, the furnishing of the brush with the right colour comes under the heading of "supply", but every time the brush touches the canvas it is 'zero hour' and then everything depends on courage and intensity of effort. Strategy and supply will not by themselves win battles, and organization is no substitute for will; they are, however, important as making for victory."

When you have said that about painting there is nothing more to be said. If you want to paint, you get the right colours (which are conditioned by the position of the object which you are attempting to paint) and then for you it is "zero hour", everything depending upon courage and intensity of effort. The difference between the greatest pictures in the world and all the others lies really and truly in the courage and intensity with which the paint is put on the canvas. And now you know all about it.

Lord Webb-Johnson supplemented Sir Gerald Kelly's remarks by showing some pictures relating to medicine. The first was a woodcut of Vesalius and the second the drawing of "the studious skeleton", one of the illustrations from *De Humani Corporis Fabrica* published in the sixteenth century. Vesalius was not his own draughtsman, but he inspired the drawings. The inscription on the pedestal, as interpreted by Charles Singer, reads "Man's spirit lives. The rest is Death's portion". Other drawings of the human skeleton from Albinus might be described as "making these dead bones live". Lord Webb-Johnson showed a picture of the base of the brain from Willis's *Cerebri Anatome* (1664). That picture was one of several drawn by Christopher Wren. Wren visited Willis in his laboratory at Oxford, and asked "What are you going to do for these dissections?" to which Willis replied, "I am going to describe them", whereupon Wren answered, "Well, I am going to draw them". Other pictures shown by Lord Webb-Johnson included the famous portrait of John Hunter by Sir Joshua Reynolds, and a portrait of William Hunter by Zoffany, also a number of drawings from Charles Bell's *Anatomy of Expression* (1806). He concluded by inviting the audience back to the Prado to admire the two pictures by Goya "La Maja Vêtue" and "La Maja Nue".

Section of Radiology

President—CONSTANCE A. P. WOOD, M.A., M.R.C.P., F.F.R.

[*February* 20, 1953]

A Technique of Simulated Rotation Therapy for the Treatment of Carcinoma of the Bronchus

By I. CHURCHILL-DAVIDSON, M.A., M.B., B.Ch., D.M.R.T.
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THIS technique was developed following reports from Scandinavia of improved results in œsophageal cancer with rotation therapy [1, 2]. The principle is the use of multiple strip fields, the portals of entry of which are moved on each successive treatment so as to simulate a single rotating field. The high percentage depth doses obtainable with rotation therapy are thus achieved without the need for any special apparatus.

The size of fields used is 6 cm. wide by 15 cm. long. A few cases have been treated with fields 10 and 20 cm. long. The axis of rotation is in the vertical plane, the patient being treated in the sitting position. Following localization of the tumour contours are taken in the usual manner. The span of skin on the front and back of the chest which is available for portals of entry is noted. In order to minimize the amount of normal lung tissue irradiated lateral beams are avoided.

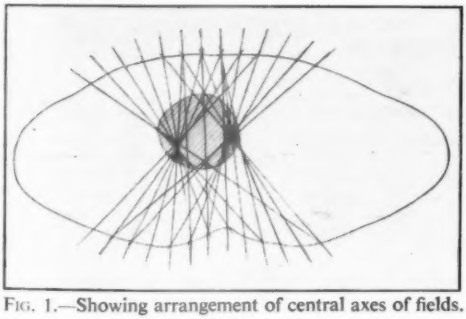

FIG. 1.—Showing arrangement of central axes of fields.

The contour is marked off at 2 cm. intervals, this spacing giving the lowest skin dose. The points are numbered and form the entrances and exits for the fields (26 on the distribution shown—Fig. 1). The beams are not all directed through the centre of the tumour but are arranged so that the tumour dose is as even as possible. The dosage to the outside fields can be loaded as the skin dose here is lower than in the centre. It is, however, better to avoid this if possible as it will increase the dosage to normal lung.

On the distribution shown the tumour area was taken as 8·5 × 8 × 15 cm., the antero-posterior measurement of the chest was 20 cm. Using a standard 250 kVp unit filtered to give a half value layer of 1·75 mm. Cu and a 6 × 15 cm. applicator with 50 cm. focal skin distance the following calculated percentage depth doses were obtained:

Tumour max. 620%, min. 455%. Skin max. 400%. (No allowance was made for the differential absorption through lung and bone, it being taken that these cancelled each other out [3].)

Six or seven evenly spaced strips are treated each day. Setting up is extremely easy, all that is required being a Perspex-ended applicator, the face of which is ruled to show the centring point, and a back pointer. Fields 1–17, 5–21, &c., are treated and the following day the adjacent strips on the right of the previously treated ones are used so that an effect of rotation is obtained.

23 cases of inoperable carcinoma of the bronchus have been treated by this technique. A minimum tumour dose of 5,000 r over seven weeks has been given to the whole volume of tissue likely to be involved by the growth. The technique would be equally suitable for treatment of carcinoma of the œsophagus.

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The following reactions occurred:

Dry desquamation of the skin with a small patch of moist in the central area in a few cases.

Moderate to severe dysphagia.

The outstanding complication has been the development of severe lung fibrosis. In all cases there was severe fibrosis of the affected lobe with some scarring in the normal lung (Fig. 2), this in many cases producing little disability, but in 4 cases massive fibrosis of the whole of both lungs occurred, the onset being approximately two weeks after the completion of treatment usually causing death within a few days (Fig. 3). This fibrosis was not confined to the irradiated parts of the lungs and there was no direct correlation with the length or number of fields used, or with the age of the patient.

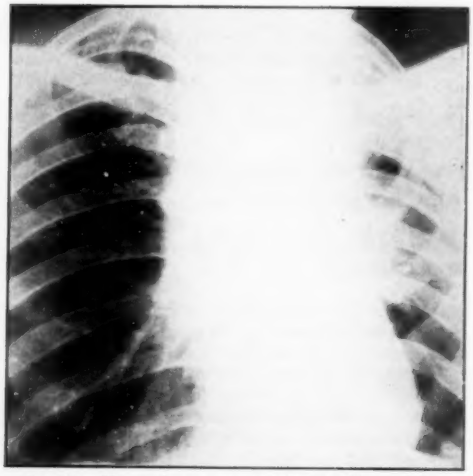

FIG. 2.—X-ray from a case of oat-cell—varying to columnar-cell—carcinoma of the left upper lobe bronchus nine months after treatment. Died twenty-six months after treatment.

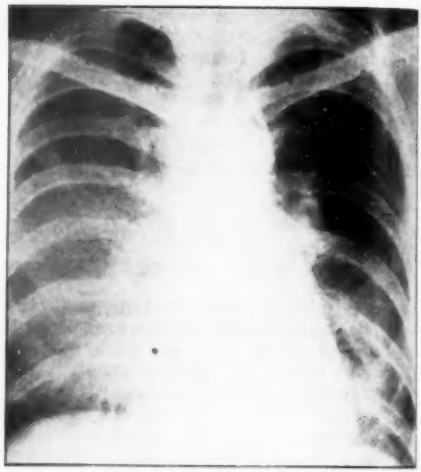

FIG. 3.—X-ray from a case of oat-cell carcinoma of left upper lobe bronchus three weeks after treatment showing fibrosis developing. Died one week later.

RESULTS

Cases treated	23
Completed treatment ..	19
Died	18
Living	1

Living Case 1

Months: 34+

Histology: None

Condition: Dyspnœa ++

Survival after treatment of the 18 cases who have died

(All cases histologically proven except the one indicated* who died of spinal metastases)

1	..	26 months	2	..	4 months
1	..	25 months*	2	..	3 months
1	..	12 months	3	..	2 months
2	..	8 months	6	..	under 2 months

Post-mortems .. .. 10 cases

Free from growth in chest, 4 (No P.M. histology in 1 case)
Residual growth in chest, 6

Died of severe fibrosis, 4 (2 free from growth in the chest—the case with no P.M. histology and 1 other)

CONCLUSIONS

(1) Owing to the risk of lung fibrosis this technique should only be used in exceptional circumstances.

(2) A dose of 5,000 r in seven weeks will sterilize the growth in the chest, both primary and glandular, in a proportion of cases of carcinoma of the bronchus.

(3) The mode of production of the fibrosis is interesting, non-irradiated as well as irradiated lung may be affected possibly due in part to lymphatic blockage.

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Uniformity of Dosage in Bladder Carcinoma

By Mary Douglas, M.D., D.M.R.T.
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In the treatment of malignant disease by radiotherapy, it is important to deliver a uniform or homogeneous dosage to a certain volume of tissue. The achievement of this aim presents difficulties in many sites, particularly so in the case of carcinoma of the bladder treated by a radon seed implant.

In an endeavour to overcome some of these difficulties, a technique for the insertion of radon seeds into a bladder tumour has recently been developed in the Radiotherapy Department of the Royal Infirmary, Edinburgh.

The instruments used are shown in Fig. 1. The jig supporting the seed introducers consists of two parallel bars, fixed 5 cm. apart and with holes in each bar 1 cm. apart. The introducers are passed through the corresponding pairs of holes in the bars and are thus held equidistant and parallel to each other. Each introducer comprises simply a trocar and cannula graduated in centimetres. The seeds are inserted in the usual way with a blunt stilette replacing the sharp-pointed trocar.

The radon seed implant is carried out in the following manner. The bladder is opened usually through a transverse suprapubic incision. We have found a Morson's ring retractor very useful in obtaining a good exposure. This instrument consists of a large metal ring to which may be attached small metal retractors and also stay sutures from the bladder wall. If the tumour is of the proliferative type, the projecting part is removed by diathermy, leaving a fairly flat tumour bed. In the infiltrating type of tumour, no preliminary procedures are necessary. The jig rests lightly on the margins of the wound (Fig. 1) and the first introducer is inserted through the first pair of holes into the bladder wall, 1 cm. from the lateral margin of the tumour and about 2 cm. above the upper margin. It slips easily along the submucosal layer. Immediately thereafter, the other two introducers are inserted through the next two pairs of holes. All three can readily be palpated as they lie in the bladder wall, and their position verified. They should extend beyond the tumour for at least 1 cm. Radon seeds are then inserted in the ordinary way at 1 cm. intervals. When the first row of seeds is in position, the introducer is removed and inserted through the fourth pair of holes. Similarly when the second introducer has been used it is inserted through the fifth pair of holes. Five rows of seeds may be implanted in this way, and if more are required, the jig is rotated through 180 degrees while the last introducer is in position.

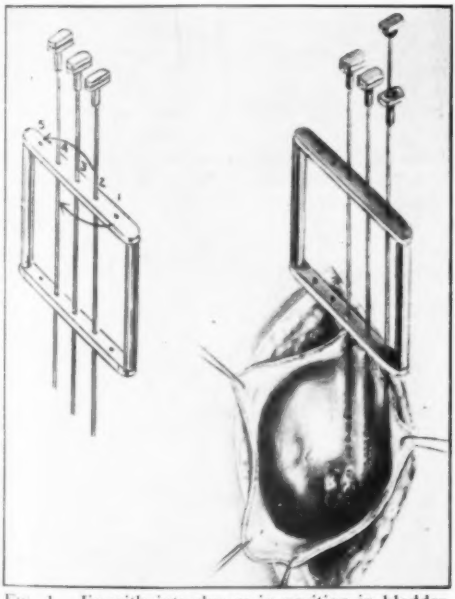

Fig. 1.—Jig with introducers in position in bladder showing method of insertion of radon seeds.

A jig with curved horizontal bars is of some assistance when the tumour is situated at the junction of the anterior and lateral walls of the bladder. Unfortunately, owing to its curvature, it cannot be rotated, thus precluding the insertion of more than five rows of seeds at a time.

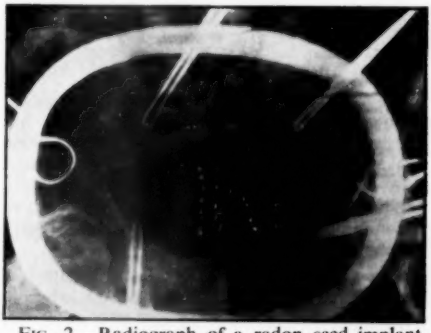

Fig. 2.—Radiograph of a radon seed implant before closure of bladder, showing Morson's ring retractor in position.

When the implant is completed and hæmostasis secured, the bladder is closed completely with transurethral drainage through a whistle-tipped catheter.

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The whole tumour area and a centimetre of surrounding healthy tissue should be covered evenly with seeds 1 cm. apart. Stereoscopic radiographs are always taken a few days after the implant has been carried out, and it has been possible to verify that the seeds are lying more or less in rows as planned. Fig. 2 shows a straight X-ray of a typical implant. Allowing for slight irregularities in the bladder wall, and the fact that the plane of the implant is not quite parallel to the film, it can be seen that the rows of seeds occupy a fairly satisfactory position.

A radon seed implant was the sole method of treatment in some cases, the dose 6,000 r.

It was felt, however, that in spite of the precautions taken to achieve uniformity of dosage a perfect implant was technically impossible in many cases, owing to contraction of the bladder wall when the tension was released at the end of the operation. For this reason it was decided to combine radon seed implantation with X-ray therapy. A dose of only 3,000 r is now given by means of radon, and this is followed by a course of X-ray therapy, giving a further 3,000 r to the tumour over three weeks by means of two opposed fields, one anterior and one posterior, each 10 cm. in diameter.

There are several advantages to be gained by this method, the main one being, of course, that it is possible to deliver a more uniform dosage to the tumour. Let us suppose that owing to irregularities in the distribution of the seeds variations in dosage of $\pm 33\frac{1}{3}\%$ occur over the plane of the implant. Where the calculated dose is 6,000 r this means that the actual dose may vary between 4,000 r and 8,000 r, leading to a danger of recurrence and necrosis. Where the dose aimed at is only 3,000 r, variations of $\pm 33\frac{1}{3}\%$ mean fluctuations in dosage of between 2,000 r and 4,000 r. With the addition of a uniform overall dosage of 3,000 r by means of X-ray therapy the total variation is only between 5,000 r and 7,000 r.

Another advantage is that weaker seeds are used. With this method the strength of the seeds is usually about 0·3 mc. compared with seeds of 0·8 to 1·0 mc. or more, which are used in an outright radon seed implant. It can readily be appreciated that the danger of high dosage due to too close proximity of two seeds is of less serious import the weaker the seeds.

Finally the method is simple to carry out and is superior to treatment by X-ray therapy only, in that the total body radiation dose is low, and skin, bladder and rectal reactions are not so marked.

X-ray treatment is started not later than two weeks after the insertion of the seeds. Apparatus of 240 kV with a HVL of 2·5 mm. copper is used. Circular fields, 10 cm. in diameter, include the whole bladder and a little surrounding tissue but no attempt is made to treat the glandular areas. The position of the fields is checked by radiographs taken on the X-ray therapy tube with the patient placed as for treatment. For this purpose the kV is lowered to about 90, the mA. to about 7 and the time of exposure is about 4 seconds. The radon seeds mark the position of the tumour and are readily identified on the film.

It is too soon as yet to assess the value of these measures but the results are promising.

I would like to express my thanks to Professor R. McWhirter and Mr. D. Band for their guidance and help in the treatment of these cases and to Miss Brown of the Department of Surgery, University of Edinburgh, for the illustration shown in Fig. 1.

Radioactive Gold in Malignant Effusions

By J. Walter, M.A., B.M., M.R.C.P., F.F.R., D.M.R.E.
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This is a record of experience of about eighteen months in the attempt to control the re-accumulation of malignant exudates in the abdominal and thoracic cavities by radioactive gold colloid. The syndrome is common, and the patient's existence is made miserable by the need for tapping every few weeks. So far, conventional treatment, radiotherapeutic or otherwise, has largely failed; any new method of promise is therefore worth exploring.

The most important of the early clinical reports in this field is by Müller (1951). Other reports have come from Jentzer and Wanger (1950), Pluygers (1950), Kent and Moses (1951), Walton and Sinclair (1952), King *et al.* (1952).

The object of treatment is to irradiate malignant deposits on the serous surfaces, and although the detailed pathology of fluid production is only imperfectly understood, it is hoped by this method to break the chain of whatever processes are responsible.

Physical data.—Radio-gold (Au ^{198}) has physical characteristics that make it suitable for clinical use. It emits beta particles of maximum energy 0·96 MeV and two soft gamma rays (0·12 and 0·41 MeV), ending as Hg^{198}. The half-life is 2·7 days, 94% of the dose being delivered in eleven days. The beta particles, which deliver most of the dose, have a maximum range in tissue of 3·8 mm. About 50% of them travel 0·38 mm., and 90% of the dose to a tissue bathed in the fluid is delivered in the first millimetre of tissue. In abdominal treatments it is estimated that the gamma rays contribute only about 5% of the dose. Their presence, however, enables us to detect and measure the radioactivity from outside the body just as in the case of radio-iodine.

The material is prepared for use in colloidal form, with a particle size of 50–100 mμ: it is therefore not readily absorbed through the serous surfaces. The total gold content is about 0·2 mg./mc. or 16 mg. for 100 mc.; in considering possible toxic effects, this may be compared with 22·5 mg. of gold in a typical 50 mg. dose of sodium aurothiomalate as used by injection in treatment of rheumatoid arthritis. The proportion of active to inactive gold is about 1 in 40,000.

Technique.—Treatment has been carried out after admission to hospital. A preliminary tap is done and the greater part of the fluid removed; it is not advisable to attempt to remove all the fluid, especially if the injection of gold is to take place on a succeeding day (as has been our practice), for a dry tap at the actual injection is undesirable owing to uncertainty about the position of the end of the needle and possible damage to viscera. Microscopic examination of a sample of fluid will often show the neoplastic cells.

The radioactive material is handled with the usual strict precautions, and transferred in the laboratory, under remote control, by pipette into a stoppered bottle. It is then wheeled into the theatre, in a lead box, on a trolley. The technique of injection is simple. Fig. 1 illustrates the procedure, using a funnel and tubing. A little saline is run in first, to guard against blockage; the stopper is removed from the bottle and the colloid poured into the funnel with the aid of long tongs; finally a little more saline is run through, to wash all the colloid into the patient. The total volume of injected fluid has been about 100–150 ml. The specific activity of the colloid has been about 2 mc./ml., involving a bulk of about 25–100 ml. for the colloid alone, but more concentrated preparations have recently been introduced which enable the total fluid injected to be considerably reduced. More elaborate and elegant forms of apparatus have been devised by several workers for delivering the saline and colloid alternately in measured amounts; so far, the simple and cheap method described has served us well and without mishap.[1]

After the injection, the wound is sealed with collodion and gauze, and the patient is rotated, first on one side then on the other, then head down, then on his face, so as to distribute the radioactive fluid as uniformly as possible throughout the cavity. These turning manœuvres are continued at intervals in the ward for the following two hours.

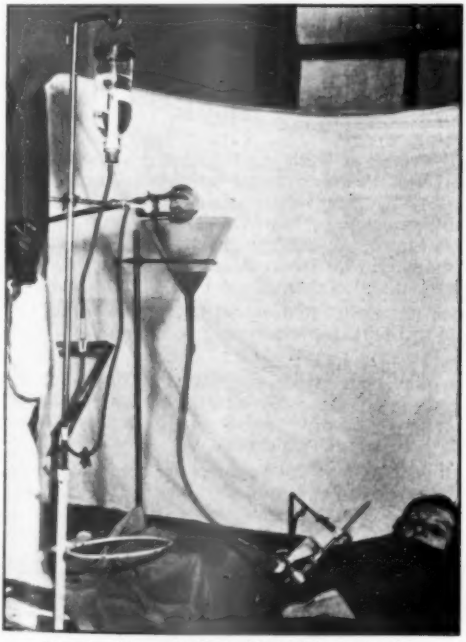

FIG. 1.—General view of instillation of gold by gravity feed.

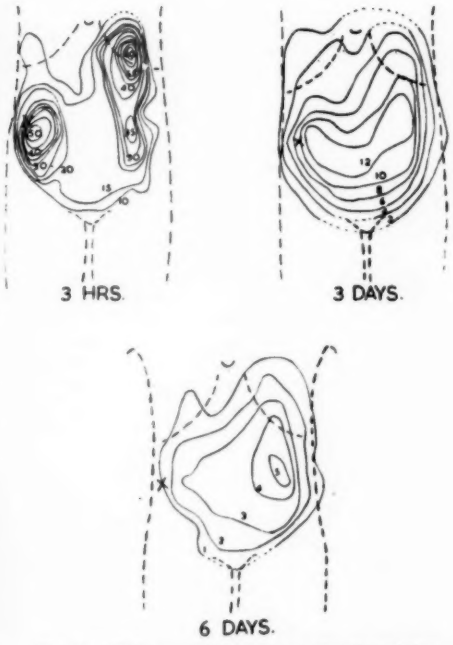

FIG. 2.—Follow-up distributions of radioactivity in an abdominal case. The curves join points of equal counting rates.

[1]Recently, an even simpler procedure has been adopted. The gold solution is drawn straight up into a syringe and injected into the patient with the help of a two-way tap. The apparatus, clamped to a stand, is mounted at the patient's side in the theatre; the overall time has been cut down to a few minutes only.

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The radiation dosage received by personnel in the theatre has been measured by means of ionization chambers and films. The greatest dose, 0·01 r, was received during the carrying of the gold into the theatre. The exposure during the rest of the procedure was negligible, with no blackening apparent on the films.

Later on the same day, a physical survey of the patient is made, with a collimated Geiger counter, and the distribution of radioactivity is charted. Fig. 2 gives examples of typical serial distributions. There is always the possibility of finding a "hot-spot" due to loculated fluid that might lead to dangerously high local dosage—in which case it might be judged advisable to withdraw radioactive fluid. Only one case has given any anxiety in this way, but a repeat survey half a day later showed that the distribution had evened itself out. Two cases have shown definite spread of radioactivity from the abdomen to the thorax; so far no spread from thorax to abdomen has been found, though the number of thoracic injections has been relatively small. Measurements of radioactivity on blood samples in 8 cases have shown amounts varying from 0·004 to 0·1% of the total injected dose per litre of plasma. Urinary excretion is similarly low, about 0·1% of the total dose.

Precipitation of gold colloid.—In the earlier batches some precipitation occurred during transit, but for the past year improved methods of preparation have given a clear and stable colloidal solution. It is of some importance to try to estimate how soon the gold precipitates on to the serous surfaces, since the surface dosage would be appreciably increased by early as compared with late precipitation. Evidence on this point can be obtained by repeated sampling of fluid after the injection; this is unpleasant for the patient but we have secured some data in 5 cases, shown in Table I. The figures

TABLE I.—TO SHOW RATE OF PRECIPITATION OF GOLD (*see* text)

"Gold Space" in Litres following Injection

Case	I	II	III	IV	V
Site	Thorax	Abdomen	Abdomen	Abdomen	Abdomen
4 hours ..	—	—	3·3	2·2	1·2
7 hours ..	—	—	—	—	1·1
1 day ..	5·8	3·4	9·1	8·0	4·3
2 days ..	—	—	—	9·5	—
3 days ..	17·3	9·8	26·0	14·8	23·0
4 days ..	—	—	—	20·0	41·0
5 days ..	—	32	—	—	41·0

given are the number of litres that would contain the whole of the injected gold if it was everywhere at the same concentration as in the sample taken; the results are corrected for physical decay. Since the reduction in concentration cannot be due to any significant extent to the production of new fluid, it seems reasonable to conclude that appreciable precipitation begins after an interval of between one and three days. This factor will clearly be relevant in considering findings such as the higher concentration of radioactivity in lymph nodes as compared with ascitic fluid five days after injection, reported by Jentzer and Wanger (1950), as also in the interpretation of our own data in Table V.

In one case the distribution was investigated with the patient first on her back, then on her side, one day after injection; the results showed the gold to be still mobile, since a considerable part of it collected at the lower side of the abdomen.

Radiation reactions.—These have been generally quite mild. In 16 abdominal injections, definite reactions appeared in 6, usually on the following day; 4 of these developed some abdominal pain with vomiting or diarrhœa; none were alarming or gave cause for anxiety. In 4 chest cases, there was some pain in one case, which was thought not to be a radiation effect.

Clinical results.—In choosing the cases, nearly all candidates with effusions were accepted as they appeared; only those seriously ill or moribund were considered unsuitable. Tables II, III and IV give details of the type of case, amount of gold injected and clinical effects.

In the abdominal cases the injected gold has ranged from 140 to 250 mc., the typical amount now being 170 mc. In 8 out of 15 cases no worth-while effect was obtained, and 5 died within a short time. In 4 of these 8, considerable masses were palpable in pelvis or abdomen; it seems logical to expect poorer results from a superficial form of treatment in such cases, and it is therefore not surprising to find them relatively less responsive.

In the 7 cases where a measure of success was achieved, re-accumulation has been controlled for periods of two to thirteen months so far. No. 1 was a case of seminoma testis after orchidectomy, a man of enormous girth, so large that we were unable to give more than a few hundred roentgens to the para-aortic nodes even with supervoltage at 2 MeV. Shortly after we abandoned treatment recurring ascites developed, with a lower abdominal mass palpable. Since his injection of 200 mc. there has been no recurrence for thirteen months, and the mass also disappeared. No other form of

TABLE II.—DETAILS OF UNSUCCESSFUL ABDOMINAL CASES
Intraperitoneal Series I Results

Total = 15 — Fluid uncontrolled in 8

No.	Sex	Primary	Dose (mc.)	Survival (months)	Remarks	
1	♂	?Stomach	200	1·5	Rapid general deterioration ? Fluid controlled	Died
2	♀	Cervix	140	3·5	Chylous fluid. Temporary control only	Died
3	♀	Ovary	170	1·5	Large secondary abdominal masses	Died
4	♀	Ovary	200	1·0	Rapid general deterioration	Died
5	♀	Ovary (? secs.)	150	5·0	Large abdominal masses. No control	Died
6	♀	Ovary (? secs.)	150	1·5	Large pelvi-abdominal mass. Fluid recurring	
7	♀	Cervix	170	2·0	Chylous fluid. No control	
8	♀	Ovary	170	2·5	Large pelvi-abdominal mass. No control	

therapy could have been expected to produce a result as satisfactory. No. 4 is of interest owing to the response apparently delayed for three months. No. 7 was an unfortunate who, before this treatment, had been tapped once weekly for two months, with about 10 pints withdrawn each time. It should be borne in mind that occasionally effusions subside for a long time after simple tapping or even spontaneously, but this is most exceptional and unlikely to be a significant factor in even a small series.

The 4 pleural cases are summarized in Table IV. In No. 4 injections were made on both sides at the same session.

Summarizing the clinical results to date, we may say that worth-while success has been achieved in something between one-third and one-half of all cases.

TABLE III.—DETAILS OF SUCCESSFUL ABDOMINAL CASES
Intraperitoneal Series II Results

Total = 15 — Fluid controlled in 7

No.	Sex	Primary	Dose (mc.)	Survival (months)	Remarks	
1	♂	Testis	200	13	Obese. Lower abdominal mass disappeared	
2	♀	Breast	150 200	9	6/12 control after first dose. General deterioration after 2nd	Died
3	♀	Cervix	140	6	Fluid controlled. Subacute obstruction terminal	Died
4	♂	? Bowel	250	8	Fluid controlled only after 3/12	
5	♀	Ovary	175	3	Fluid controlled. Deteriorating generally	
6	♀	Ovary	150	4	Large masses. Fluid controlled	Died
7	♀	Ovary	170	2	Weekly taps before treatment. Fluid controlled	

TABLE IV.—DETAILS OF THORACIC CASES
Intrapleural Series Results

Total = 4

No.	Sex	Primary	Dose (mc.)	Survival (months)	Remarks	
1	♀	Breast	90	3	No control	Died
2	♂	Lung	90	1	No control	Died
3	♀	Breast	50	1	Controlled to date	
4	♀	Breast	50 Each side	2	No control	Died

Some post-mortem findings.—Case No. 2 of Table III did well for six months following injection of 150 mc. Recurrence then set in, for which 200 mc. were injected; death took place a month later. At autopsy, there was striking thickening of all peritoneal surfaces, especially over liver and spleen,

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which showed a gross "sugar-icing" appearance; the mesentery was about an inch thick. Fig. 3 shows the enormous fibrotic thickening over the spleen. The process appears to involve fibrinous deposition with subsequent organization to fibrous tissue. The radioactivity would be the *prima facie* cause of this reaction, though the metallic gold itself, quite apart from the very small radioactive fraction, may be at least in part responsible. Such an organized layer may well act as an effective seal on the serosal surfaces, blocking the path of exudation. On the other hand, fibrosis of this degree could perhaps be a contributory factor in promoting intestinal obstruction; this is in any case a common terminal event, and the contributory role of the gold, if any, would be in doubt without post-mortem confirmation.

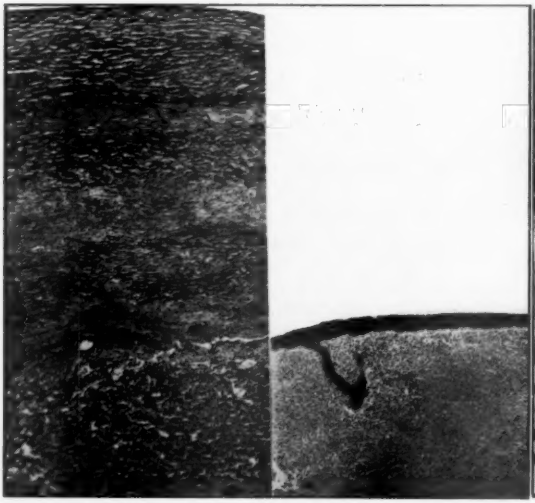

FIG. 3.—Left—surface of spleen showing fibrous thickening of peritoneal coat. Right—normal spleen for comparison, on same scale. The splenic substance reaches the same level in each picture.

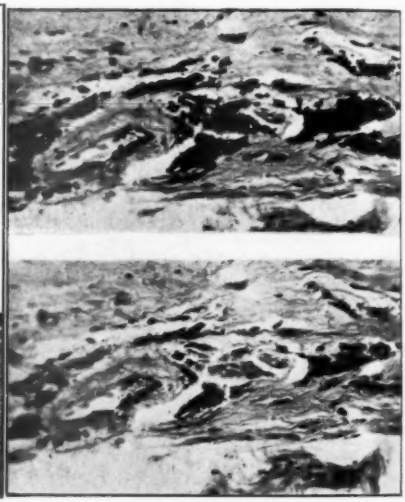

FIG. 4.—Above—peritoneal surface showing masses of colloidal gold particles. Below—same section after dissolving out gold by cyanide.

Another possible cause of fibrosis is a scirrhous reaction to the growth itself. This was seen in Case 2 of Table IV. At autopsy, the pleura on the injected side was markedly opaque and thickened, but microscopical examination left little doubt that this was mainly a reaction to the widespread growth which was invading lung, pleura and diaphragm; similar though much earlier changes were seen on the opposite untreated side. In contrast with this case, no such evidence of growth as the cause of the fibrosis was seen in the previously described abdominal case.

Tissue dosage.—The question of dosage is difficult and involved, depending on various imperfectly known factors such as volume of fluid, extent of surface exposed, rate of deposition of colloid, &c. Some direct evidence was obtained from specimens of organs removed in the above-mentioned abdominal case, and the data are given in Table V. The specimens were dissolved in hydrochloric acid and dosage estimated by liquid counting. The doses given were based on the assumption that the radioactive material was deposited in the tissue at once and decayed in situ; this is not, of course, true in practice and the doses are therefore upper limits.

Fig. 4 demonstrates gold particles in the peritoneum, as seen microscopically. For confirmation of their nature, the same section is shown after washing in 5% sodium cyanide solution. Cyanide dissolves out iron, silver and gold; the presence of silver can be ruled out, while iron can be demonstrated by appropriate stains. This reaction may be used to differentiate particles of carbon in lung and pleura, which are commonly present.

Prophylactic use.—Another possible application of radioactive gold readily suggests itself—to deal with malignant cells spilled at operation, e.g. after the common accident of a ruptured ovarian cyst. Gold instilled intraperitoneally at the end of operation, or soon after, might have a decisive effect in eliminating early possible seedlings. Our own experience is confined to a single case, where a little pseudomyxomatous jelly was found in the pouch of Douglas. 135 mc. were instilled, and there has been no clinical recurrence for nearly two years.

This is a field that merits further exploration by a controlled series.

TABLE V.—CONCENTRATIONS OF RADIOACTIVITY AND TISSUE DOSES FOUND AT POST-MORTEM

Post-mortem Specimens

200 *mc. radiogold injected into peritoneal space 28 days before death*

Specimen	μc/cm².	μc/gm.	Dose (er)
Liver surface	4·0	—	5,600
Liver substance (edge)	—	1·15	87
„ „ „	—	3·90	450
„ „ (centre)	—	1·03	72
Liver peritoneum	4·5	—	6,300
Pancreas	—	0·72	55
Small bowel	13·5	—	18,200
Large bowel (surface)	30·0	—	42,000
Mesentery	4·5	—	6,300
Spleen (substance)	—	1·74	133
„ (peritoneum)	9·4	—	13,200
Ovary	—	11·60	880
Parietal peritoneum	9·2	—	13,800
Peritoneal fluid	—	1·40	—

Concentrations are corrected for physical decay to time of injection.

Estimated doses on assumption of immediate deposition of gold in these concentrations and so are upper limits.

Surface doses assume a precipitation of 16 mg. /mc. of solid matter in the colloid.

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[The paper by Dr. Charles L. Lewis on "Treatment of the Meningeal System Using Radioactive Isotope and Wedge Filters" will appear in the next issue of the Section of Radiology.]

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(As no reviewing is undertaken in the "Proceedings" this list is the only acknowledgment made of books received for review)

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